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An empirical investigation of selected hypotheses related to the success of management information system projects.

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AN EMPIRICAL INVESTIGATION OF SELECTED HYPOTHESES RELATED TO THE SUCCESS OF MANAGEMENT INFORMATION SYSTEM PROJECTS

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CHAPTER I

INTRODUCTION

The Problem

> "It is becoming increasingly obvious that the full potential of information processing will not and cannot be realized until computers and their applications can be managed reliably in an economic sense (Weinwurm, 1968, p. 329)."

Weinwurm's above comment at the 1968 National Conference of the Association for Computing Machinery could well be taken as the underlying imperative for this research. Computers have had great impact on our economy, on organizations, and on individuals in the past fifteen years. They have been cursed and praised. The literature of virtually every discipline contains increasing references to computers.

However, one recurrent theme that keeps appearing over and over again when computerized information systems are under discussion is the failure of organizational managements to capitalize on the potential offered by computer technology. Many accounts of such management shortcomings could be cited, and some will be cited further on, but Reynolds (1968) summed up the essence of all of them quite succinctly when he said:

> "The common complaint among people who must plan for and manage the development of computer program systems is that the products are almost always finished over budget and late, and they hardly ever do what they were intended to do (p. 334)."

John Diebold (1969), a pioneer in the information systems field, has predicted that "by 1985, the computer will have become central to the nervous system of the corporation." Diebold (1969) has also pointed out that the "share of personnel and software cost in the total ADP mix" has substantially increased in the past five years to the point where these costs often amount to twice the annual hardware cost. Both of these factors lead one to the conclusion that the management of management information systems (MIS) should be the focus of much attention and research.

The Need

Before proceeding to a statement of the purpose for the present research, the following rather extensive quotation from Weinwurm (1968) emphasizes the need for the type of research conducted by the author and reported in this thesis:

> "Of the explosive and unremitting change that is characteristic of information processing there can be no doubt. Nonetheless, there is a great difference between noting the pace and dynamism of the field and asserting that, as a result, management research is bound to be wasteful--no matter what the investment in it, regardless of the probability of success, and whatever the savings that may result. The empirical evidence that can be marshalled in support of such a compound assertion is rather meagre. Indeed, it is doubtful whether a deliberate policy of investing in management research on a scale that is in some substantive sense proportional to the magnitude of technical development has ever been seriously attempted.

"Similarly since all possible innovations and contingencies obviously cannot be anticipated, learning by experience is a necessary concomitant to any technological advance. Adopting 'trial and error' as a governing policy is another matter altogether. There is considerable reason to believe that the real costs of information processing 'trials' are far, far higher than is generally recognized. In fact, due to the ingenious ways by means of which we have learned to obfuscate learning inefficiencies, the real costs are very likely indeterminate. In any case, no serious attempt has ever been made to demonstrate that 'trial and error' is the most economically effective--or the most expeditious--way of advancing the state of the management art; perhaps because such a demonstration may well involve contradictions of a rather fundamental nature.

"Finally, there are undoubtedly rather basic similarities between information processing and any other process that involves men and machines. At the same time, these resemblances can be carried beyond the point of supportability. While the general validity of certain principles of good and effective management can be assumed, information processing in many respects differs from the manufacturing processes upon which much of our management knowledge is based. To the extent of these differences--which are expecially evident, for instance, in computer programming--literal and indiscriminate application of traditional management principles can on occasion evoke rather preposterous management policies. Hence, the critical issue is not whether well-established management methods are entirely relevant or whether completely new variations must be developed, but which combination of the old and the new is most appropriate to and effective under each circumstance.

"In any case, whever the 'truth', collectively, lies, one would expect these differences of opinion to be discussed by the leading experts, with the support of a reasonable assortment of facts instead of assertions, in and through the formal meetings and journals that the relevant societies provide for such purposes. That,

after all, is the professional and scientific way such issues are resolved. Regrettably, very little if anything of this kind has happened. It is true that there have been hundreds, and probably thousands, of discussions, symposia, articles, tutorials and the like, during the past 10 years, but nearly all have been on a transparently superficial, often amateurish and promotional level. And one finds it difficult to hear of comprehensive, comparable, or reliably-analyzed experience-data--let alone the management measures and standards that derive from such data--anywhere.

"I believe that we cannot abide this situation any longer. It is high time that the management of information processing was brought into the mainstream of professional discussion; i.e., that theses be formally advanced and supported by facts in a respectable manner; and that this be done 'on the record' so that others will be stimulated to counter in the same fashion."

. . . .

"While the lack of a generally available, accepted, or applicable management methodology is a serious problem in nearly every area of information processing, I believe most experts would agree that the greatest confusion and the most critical need is in the management of computer programming--in the broad sense of the term. Moreover, software-related problems--by every present indication--will increase far more rapidly in their scope, complexity and economic impact than will their hardware counterparts during the forseeable future (pp. 330-331)."

Purpose

The purpose of the research detailed in this thesis can perhaps best be summarized by the question:

What organizational and procedural factors are correlates of success with MIS projects?

Raising such a question and pursuing its answers are predicated on the hypothesis that there are certain organizational and procedural variables which have a meaningful influence on the success or failure of a given MIS project, and that these variables can be identified. Further, upon identification, such variables can be manipulated in certain ways under certain conditions to enhance the probability of success with a given MIS project.

Definition of MIS

Before going further, it is necessary to define just what is meant by a "management information system" since there does not appear to be much consensus on a definition among either authors or practitioners in the field (Dickson, 1970). One can arbitrarily designate any system or method that provides information for the decision-making functions of management as a MIS. A great many sources of management information beyond the scope of the usage in this thesis would thus qualify as a MIS. (For example, the Wall Street Journal.) However, the term MIS has only come to be used extensively since the advent of electronic computers for processing information to aid managerial decision-making. In fact, it would appear that a great many people equate MIS and the computer.

It is this latter equation that the author considers to be incorrect. There have been, and are today, many kinds of computer applications which should be classified as data processing

applications as opposed to MIS applications. The perennial favorite, when such a distinction is raised, is a payroll application which is merely converted from one form of processing (manual or punched card) to some other form (computer). Another example of a non-MIS computer application would be an inventory-control system which merely does on the computer what stock clerks were doing with card files, and nothing more. However, the inventory-control application could <u>become</u> a MIS if upgraded to the point that summarized or analyzed data were made available to management for the express purpose of making decisions on such questions as balancing workloads, make or buy, and optimal forms of distribution to minimize cost and maximize service. The last example might be viewed as the threshold for qualifying as a MIS application, since some of the kinds of decisions cited could be programmed and handled by the computer under certain circumstances. The important distinction, then, is that for a computer application to be considered a MIS application, a manager at some level (not just the corporate executives) must be receiving information from the computer which aids him in making decisions within his domain of responsibility. Such decisions could be of either a planning nature or a control nature, or both.

The Focus

Three additional points require elaboration with respect to the stated purpose of this research. First, the

focus of the research reported here, or "element", using the terminology of Lazarsfeld and Menzel (1961), is the MIS project. This is a distinct departure from previous empirical studies of various aspects of computer usage in organizations. Generally, the element studied has been the overall organization or some segment of the organization. For example, there has been considerable attention devoted to the impact of computers on the organization (Shultz and Whisler, 1960; Myers, 1967; Reif, 1968). Another approach used in studying the organizational implications of computers has been to use the information systems function, or "computer complex", as the element (Reichenbach & Tasso, 1968). This latter method involves trying to evaluate the impact of various organizational variables on the effectiveness of the overall computer effort.

The assumption here is that if methods can be found to increase the probability of success with specific MIS projects, the overall success of the total MIS effort will logically follow. While this is a strong assumption, it is further assumed that an organization doing a good job on a project by project basis will not completely neglect long-range MIS planning and integration. At any rate, it is believed that more meaningful hypotheses can be posed and tested for the individual MIS project than for the entire MIS effort of an organization. Further, there is need to evaluate the effectiveness of given practices in more discrete situational contexts than the total organization,

since project characteristics may possibly vary in such a way as to call for differential treatments.

The second point requiring elaboration follows directly from the definition given of the MIS project, and is related to the point about project orientation. As noted, most previous studies have dealt with the total organization in looking at MIS success, and in doing so have encompassed an indeterminable amount of information system development activity that the author would not consider to be MIS. This has had a confounding effect because the requirements for effective management of MIS activities appear to differ in some respects from the requirements for success with non-MIS activities. Specifically, it is the author's contention, supported by the data collected and analyzed in this thesis, that development of information systems for decision-making in the various functional and executive areas places a greater premium on involvement and integration of functional managers and executives than does development of non-MIS computer applications, which may have evolved fairly directly from existing procedures. This view is supported by several authors in the field (Canning & Sisson, 1967; Ditri & Wood, 1969; Lipperman, 1968; Reichenbach & Tasso, 1968).

The last point above has particular relevance when viewed in the context of the future prospects for computer usage in organizations. Many organizations have about come to the

end of the road on non-MIS computer applications, and are, therefore, looking to the opportunities offered by the more sophisticated and complex MIS applications. A report by Scientific American, entitled "The Computer Market" (1968), showed that only 39.9% of 1450 responding organizations were using computers for MIS applications at the time of the study, compared to 73% using computers for accounting and payroll applications. However, the report showed that 90% of the responding organizations planned to use computers for MIS applications in the future (p. 17). Thus, if there are major differences in the organizational and procedural variables related to success with MIS projects, as opposed to those variables related to success with non-MIS projects, findings of previous studies of the total organization's MIS efforts may not hold up in this new MIS environment. On the other hand, it may be that the same variables work in the same directions in both cases, or that the findings of earlier studies may have reflected the MIS part of the application mix. Unfortunately, the resolution of these uncertainties is impossible due to the nature of the data reported in previous studies.

Finally, the research reported in this thesis is a break from the tradition of the intensive one-case study at one extreme, and the large-scale questionnaire survey at the other. The approach in this research has followed the lines proposed by Mouzelis (1969), in that a small sample has been

studied rather intensively; not as intensively as for a one-case study, but more intensively than is possible with a widespread questionnaire survey. Further, the sample, although small at twenty projects from ten organizations, represents a diversity of organizational environments, which affords the opportunity for greater generalization than the one-case approach.

Organization of the Study

The author's prime objective in conducting the research reported in this thesis has been to add to the body of knowledge concerning the development and implementation of MIS projects. Specifically, an effort has been made to determine what organizational and procedural factors relate to MIS project success. It was recognized at the outset that one research effort could only scratch the surface in a field where so little definitive research has been done. However, it was felt that a well structured exploratory study, dealing with empirical data, could provide not only answers to some perplexing questions in its own right, but, more importantly, help to define more explicitly those finer-grain questions upon which additional research could be focused.

In pursuing the above objectives, the literature on information systems, computer data-processing, and project management was reviewed to determine what other authors have had to say that was relevant to the subject at hand. The results of that review are reported in Chapter II.

Based upon the literature survey, the author's own experience in the information systems field, and the suggestions of faculty members and fellow graduate students at the University of Minnesota, a research design was gradually evolved which it was believed would facilitate satisfying the research objectives. Essentially, the approach involved defining a number of hypotheses which could be tested with empirical data. These hypotheses, along with the criteria of MIS project success, are presented in Chapter III.

Following the enumeration of hypotheses to be tested, and the specification of success criteria, the detailed methodology of the study was worked out. The original set of hypotheses was reduced to more manageable proportions; an interview instrument and procedures for data collection were developed and tested; the study sample was selected; and the method of data analysis was decided upon. Chapter IV deals with these aspects of the study methodology.

The data that were collected have been presented in two ways: Chapter V deals with the organization and project samples in descriptive terms, which gives the reader a "feel" for the subjects included in the study; Chapters VI and VII present the results of statistical tests on the relationships among the hypothesis, criterion, and other variables for which data were collected. (See Appendix E for the list of all variables in the study.)

Chapter VIII consists of a summary of the study findings, along with some interpretive comments by the author. Conclusions drawn by the author, as well as suggestions for future research directions, are presented in Chapter IX.

CHAPTER II

SURVEY OF RELEVANT LITERATURE

The survey of literature relevant to the procedural and organizational variables relating to success with MIS projects will be developed along two basic lines: that literature essentially prescriptive in nature but not founded on empirical studies, and that literature reporting the findings of empirical studies.

Prescriptive Literature

The prescriptive literature will be considered in two different categories. First to be dealt with will be the literature pertaining to what can generally be classified as organizational factors. This category includes such subjects as the location of the MIS function within the overall organization structure, the degree of executive involvement in MIS development, the participation of user departments in MIS development, the selection and training of MIS staff, and the specific organizational structure for given projects.

The second category of prescriptive literature is concerned with MIS project planning and control factors, and is comprised of such topics as definition of project objectives, documentation, allocation of manpower resources to projects, cost estimating of projects, the development and application of standards to project personnel, and the use of various

project control techniques similar to CPM or PERT.

Organizational Factors

A topic that has received a great deal of attention in the literature on information systems is the location in the organization of the information systems function. Diebold (1964) has contended that organizations have failed to adapt to the requirements for effective information systems by not giving adequate attention to a specific place in the organization for MIS functions. Reichenbach and Tasso (1968) have pointed out that the location of the MIS function has been determined in many cases by the nature of early computer applications, not the requirements of the current situation. Since early use of the computer was often oriented to accounting functions, the computer activity was placed under the controller and has frequently been left there. Whitmore (1966) has argued that the location of the MIS function within the controller's organization is a natural placement, in consonance with the controller's overall responsibilities, and should, therefore, remain there. Others, notably Cole (1966) and Brandon (1970), have merely held that the MIS function should be placed at a high level in the organization, commensurate with the responsibilities of the MIS manager. A counter point of view to Whitmore's, expressed by Canning and Sisson (1967), and Aukerman (1966), is that the MIS function should definitely

not be under the controller or a financial executive; rather, that it should be located directly under the top executive as an independent function. Finally, Reif (1968) has reviewed the literature bearing on organizational placement of the MIS function and has provided an analysis of the different points of view. In summary, it would appear that the literature on organizational location of the MIS function leans toward the prescription of independent function status at a high organizational level, although this position is not unanimously held.

A second organizational factor which has received attention in the literature is the necessity for top management and user interest and participation in directing and controlling the development of MIS (Aukerman, 1966; Brandon, 1970; Canning & Sisson, 1967; Gallagher, 1961). The basic position held in common among these writers is that only through active participation and assumption of responsibility for results can executives and managers expect to derive the potential benefits from their management information systems. In the absence of such positive direction, the MIS will end up being what the MIS staff provides, which may or may not be what is really needed (probably the latter).

With respect to staffing the MIS function, Canning (1967) and Whitmore (1966), among others, have prescribed means of selecting, developing and organizing the MIS staff. Campise (1968) has paid special attention to the need for

highly qualified MIS project leaders who are capable of effective communication with user personnel. Finally, Canning and Sisson (1967), and Ditri and Wood (1969) have advocated the use of interfunctional project teams composed of MIS staff and user personnel as a means of achieving higher quality MIS products and user organization acceptance of change.

<u>Project Planning and Control Factors</u>

Various aspects of MIS project planning and control have been dealt with in the literature. Probably the best known sources are Lecht (1967) and Brandon (1963; 1968). Lecht covers virtually the entire range of activities relating to project planning and control, while Brandon's scope has been more narrowly confined to the development and application of performance and methods standards. LaBolle, et al (1965), working at the System Development Corporation, have developed a comprehensive planning guide for computer project development which also deals with almost all areas of project planning and control.

Schwartz (1964) has stated that "Inadequate planning is at the root of most data-processing failures and over-runs (p. 14)." He has proposed using a "Work Breakdown Structure" to formalize and improve the planning, direction, and control of projects. Mensh (1969) has advocated using techniques which appear to be quite close to Schwartz's work breakdown structure.

Blumenthal (1969) has provided what is probably the most thorough and articulate statement of the way in which an

organization should approach its total MIS effort, as well as how specific projects should be handled. Blumenthal advocates setting up an analytical framework based on functional areas of the organization. All proposals for MIS projects are then evaluated within the context of this framework. Blumenthal also provides a detailed, step by step procedure for the generation, selection, development, implementation, and audit of MIS projects.

Some authors have recommended the use of such formalized project planning and control techniques as PERT (Canning & Sisson, 1967; Tannert, 1969) and PEST (Program Planning and Scheduling Technique, Anderson, 1966). The difficulty usually cited as inhibiting the utility of these critical path methods is the inability to make accurate resource requirement and time estimates. Pietrasanta (1968) has dealt explicitly with this problem in a discussion of estimates for manpower, machine-time, money, and project time. A much more thorough treatment of this same problem, and one based on empirical data collected by questionnaires for 169 computer programs, has been provided by Nelson (1967).

Finally, documentation methods and requirements for MIS projects have been proposed by Snyder (1965), Kay (1969), and Tannert (1969). In fact, with regard to project documentation, nearly every writer in the field of MIS management has lamented the pervasive lack of adequate project documentation, and exhorted MIS management to recognize and deal with this problem.

Empirical Studies

As was indicated earlier, all of the empirical research which has been reported (or at least found by the author) in the MIS area has focused on the overall organization rather than the individual project (with the exception of the SDC work on programming costs; Nelson, 1967). Most of this research has been accomplished either by management consultants or the American Management Association. The data for these various studies have generally been collected by questionnaire or interview, in some cases a combination of the two. For ease of presentation, the empirical studies will be discussed in chronological order.

Based on the experience of 124 companies with data processing systems, Baumes (1961) drew several conclusions which he put in the form of recommendations for any organization planning to develop a computerized information system. The key point made by Baumes was the need for detailed planning of the tasks involved in information systems development. Such planning should be predicated on a clear statement of organizational objectives, and should definitely give close attention to behavioral factors, as well as technical factors.

Thurston (1962) has reported a study of 32 case histories of organizations' data processing activities. His primary conclusion was that a critical element in success of information systems was operating management's control of systems

planning.

Perhaps the best known of the several studies which have been conducted by management consultants were the two by McKinsey & Company (Garrity, 1963; Unlocking the Computer's Profit Potential, 1968). Both of these surveys, based entirely on interview data, were aimed at determining what organizational and methodological factors had the greatest bearing on the successful usage of computers in the organizations studied. The 1963 survey consisted of a sample of 27 companies representing 13 industries. The 1968 survey covered 36 companies, also representing 13 industries. Those generally interviewed were the chief executive officer, the head of data systems, and other selected members of management concerned with the problem of effective computer utilization.[1]

The conclusions drawn from both McKinsey surveys were essentially the same. These conclusions, briefly, were the need for top-management involvement from systems conception through implementation; the need for expecting top performance from the systems group across a wide spectrum of applications; and the need for the participation of user personnel in all levels of systems design and implementation. Those companies surveyed which were judged successful in their computer

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[1]This information was provided by Mr. David B. Hertz of McKinsey & Co. in personel correspondence with the author dated 26 November 1968.

operations all evidenced these organizational and managerial characteristics.

A very general questionnaire survey of 300 business firms using computers was conducted in 1964 by Business Automation (Kornblum, 1964). The objective of this survey was to find out how successfully computer installations were being used and managed. It appeared that the questionnaires were completed mainly by data processing personnel as the conclusions seemed to reflect the attitudes of the computer systems staff toward others in the organization. For the most part, the opinions expressed indicated that those outside the computer systems function did not understand the computer or how to use it; they did not understand the unique problems and needs of computer systems personnel; and they resented the encroachments of computer systems in their functional areas.

The American Management Association sponsored a survey in 1965 (Higginson, 1965) with the primary objective of determining how the companies studied were using computer equipment, and the impact of computer systems on their organizations and operations. This survey was conducted both by questionnaire and interview. Questionnaires were returned by 288 companies of 966 solicited, and interviews were conducted in 21 firms to get more in-depth information as well as to get a subjective "feel" for the attitudes of management personnel. The conclusions were quite similar to those already cited from

earlier studies: the need for greater top-management direction and control of the computer systems function; the need for closer integration of staff specialists and operational management in the development and evaluation of information systems; and the need to consider the computer systems function just like any other functional unit with respect to organizational structure and evaluation of effectiveness in terms of corporate objectives.

Two comprehensive surveys have been conducted by Booz, Allen and Hamilton, Inc., the first in 1966, and the second a year later (Computer Operations in Manufacturing Companies, 1966; Computer Management in Manufacturing Companies, 1967). Both surveys were virtually identical in purpose, varying primarily in the sample sizes and means of collecting data.

In the first Booz, Allen & Hamilton survey, the stated purpose was "to determine what successful manufacturing companies have done, are doing, and plan to accomplish in using and managing the computer." The key here was "successful". Only those companies in the various industries studied with the fastest growth and greatest return on investment were surveyed, since it was the objective to determine how exceptionally well managed companies were using the computer. The second survey, conducted in 1967, was different only to the extent that a wider range of data covering an expanded sample was sought.

The 1966 survey was conducted entirely by interview, using no questionnaire as far as can be ascertained. Thirty-three companies were included in the survey, and 189 interviews were conducted within them. Over half of the in-depth interviews were conducted with top and operating management. The findings were then evaluated in an attempt to correlate computer usage and management with success of the company in question. The 1967 survey used a sample of 108 manufacturing companies, and questionnaires were employed to collect the data. The questionnaires covered organizational structure and practices in each company, as well as specific information on computer costs, usage and plans.

The conclusions drawn from both surveys were mainly enumerations of the various composite computer management characteristics for successful companies. The reports did indicate that a trend was developing toward more top management and operational management involvement in computer systems plans and audits. Further, it appeared that the trend was to move the overall responsibility for computer activities away from financial executives to a computer executive at top corporate level.

A questionnaire survey, conducted in 1967 as part of the Diebold Research Program (<u>Summary Report of a Survey on the Cost Effectiveness of Software & Hardware</u>, 1967), was designed to explore the future management implications of

computer information systems, and to develop some standard measurements of the cost effectiveness of hardware and software. The respondents to the questionnaire represented 17% of those solicited, and consisted of senior information systems management, technical staff reporting to information systems management, and top corporate management. The findings of relevance here were that in the majority of cases top management was not active in guiding the growth of information systems activities, and that new computer applications were often proposed by information systems management rather than those closer to the application area, namely, user management. The major problem with proper utilization of computer information systems was found to be the lack of concern on the part of management for maximum utilization. It was also concluded that larger computer users were more likely to have budget and control procedures for information systems activities, and were generally getting greater return on their information systems investments than smaller users.

Lipperman (1968) has reported the results of investigations in twelve organizations using computer information systems. His data, collected by interview, were organized on a case basis to portray what various types of organizations have done to successfully implement computer systems. Lipperman dealt with both "operative" systems and planning systems, and pointed to the latter as the direction in which information

systems should develop as operative subsystems are integrated at higher levels. This particular study would seem to be the first dealing specifically with MIS as defined in this thesis.

Several points were made by Lipperman which are of special interest here. As organizations moved toward higher level systems that integrated information from various subsystems, more user management responsibility for defining system requirements was essential. Following from this was the need to locate the information systems function high in the management hierarchy, independent of such other functional executives as the controller or financial vice-president.

A study undertaken for the American Management Association, under the direction of Reichenbach and Tasso (1968), was based on the hypothesis that "the location of the computer complex within the organization will affect the complex's operations (p. 16)." This study consisted of in-depth interviews with three levels of management in sixteen companies representing nine industries. The organizational members interviewed were top executives, information systems personnel, and user organization managers. Although numerous conclusions were drawn from the sixteen case studies, the gist of the findings can be summarized briefly as follows:

> The location of the computer complex does have a very real relationship with its effectiveness in meeting organization needs. (No evidence was provided on the measure or meaning of effectiveness.)

> The computer information systems function should report directly to top management, and should not be a part of any existing traditional function.
>
> The centralization of the computer activities need not have any impact on the traditional form of the corporate structure. The latter is a function of management's philosophy and objectives.
>
> The nature of an organization's basic activities and processes bears on the ease of its development of computer information systems.
>
> Participation by top level and user management in the development of information systems will enhance acceptance of those systems, improve utilization of the computer, and provide results more responsive to management's needs.

A monograph by Reif (1968) reported the findings of research he conducted for his doctoral dissertation in 1966. The literature survey comprising Chapter 2 of this monograph has been cited previously. The focus here will be on Reif's research methodology and findings. The impetus behind Reif's research was his belief that a major obstacle facing organizations attempting to achieve maximum benefits from computer systems was the conflict between the imperatives of computer technology and the traditional structure of business organizations.

> "There is a growing number of well-documented studies which show that the two are not compatible; yet most firms today are content to achieve limited results by super-imposing advanced information systems on organizational structures which are unable to adjust to the new requirements and interpersonal relationships dictated by the systems design (from the Preface, p. iv)."

The specific purpose of Reif's study was "to examine what structural changes occur following the implementation of computer systems in business organizations (p. 41)." This purpose was enumerated into several explicit factors such as the locus of decision making within the management hierarchy, formal and informal communication channels, and the functional integration of organizational activities. In addition, Reif studied the role of the computer systems staff, its location in the organization, and its relationships with user departments.

Reif used the case method for studying three firms: a utility company, a bank, and a manufacturing firm. Most of the data were collected by interviews, both structured and unstructured. The remainder of the data came from company records. Before considering Reif's findings, it is important to note that his data reflect a considerable number of non-MIS computer applications, what might be termed "production" jobs, as opposed to the kind of decision oriented management information which is the focus of the current research.

Based on his research, some of Reif's conclusions were:

> The presence of the computer resulted in centralizing decision-making within the management hierarchy.
>
> Line-staff relationships were changed. The computer staff group exerted great influence and made decisions affecting the internal activities of operating departments. This staff influence was de facto, not usually legitimized by formal organization structure.

> Lateral flows of communication throughout the management hierarchy were formed and expanded. However, formal channels of communication were not generally revised.
>
> The impact of computer systems will be greatest on middle management as routine administration and control decisions become programmed; these positions will generally decrease in number. However, the impact on middle managers will vary, depending on the organization, top management's objectives, and the functional area concerned.
>
> The hierarchical structure will be retained in organizations but "certain changes in the management framework appear to be imperative if the firm is to maintain harmony between information technology and the structure of organization (p. 114)."

In an attempt to measure the effectiveness of management information systems in terms of profitability, a questionnaire survey was initiated by S. D. Leidesdorf & Co. in 1967 (<u>The Profitability of Management Information Systems</u>, 1969). Of 142 companies requested to participate in this survey, 130 did so. These 130 companies, representing eleven industry groupings, were known to be using computers, "presumably effectively."

Although the objective of the Leidesdorf study dealt specifically with the terms MIS and profitability, the use of these terms may be somewhat misleading. The profitability measure was derived by asking the participating companies "to express as a percentage the influence of their computer operations and associated expenses on profitability during their first five years (or less, where that was appropriate) of computer-based

data processing (p. 18)." This approach raises two issues: first, from information contained in the study report, it is impossible to determine what data went into each company's response on profitability, or how that data was aggregated to make the requested computation; and second, since the requested computation dealt with the early period of each company's computer use, it is highly probable that return from MIS applications was greatly confounded, if not overshadowed, by return from non-MIS applications. This latter observation is made in view of the tendency for organizations installing computers to implement cost-displacement applications first, with MIS applications following as more experience and sophistication are acquired.

With respect to the results of the Leidesdorf study, 32 of the 130 companies were viewed as being successful with their MIS in terms of the reported percentage profitability contribution of MIS. The study concluded that these 32 companies achieved the high MIS contribution to profitability by "intelligent planning and control". For the 98 companies viewed as not successful in terms of MIS contribution to profitability, the report stated that:

> "The common denominator seems to be deficiencies in planning associated with the operation. To a lesser extent, the absence or incompetence of functional and/or executive participation in the planning and operation of the project appears to be a contributing factor (p. 21)."

To summarize the Leidesdorf study, it was concluded that:

> "Management information systems represent a favorable field for investment and can make a real contribution to profitability--especially through improved control of the business; but positive results are not automatic and guaranteed. Serious problems can and do arise and are usually attributable to deficiencies in management involvement, planning, and control (p. 24)."

Before concluding this section on the survey of the literature, two doctoral dissertations warrant mention. Holsinger (1970) studied the constraints to implementation of data processing systems, and examined the roles of key decision makers involved in implementing such systems. Holsinger obtained his data through interviews with members of top management, key technical personnel, and "third party representatives." The constraining variables were categorized as technological, organizational, and individual. Holsinger concluded that the relative importance of these three categories has shifted over time; that as size increases, the importance of technology and organization increases at the same time that the importance of the individual decreases; that size influences the organization's ability to utilize a proper division of labor; that control problems were created through the determination by technologists of critical aspects of systems design; and that structural problems of integrating systems functions with various types of information systems appeared.

The second dissertation, by Hodgetts (1968), is of interest since it deals with project management. Based on the research he conducted, Hodgetts advocates the project approach as opposed to the functional approach where an organization is confronted with managing a specific, complex task with stringent quality parameters. He enumerates the pros and cons of the project management approach and points out that it is a management tool not an organizational panacea. Of particular interest are his observations concerning the interface problems between the project organization and the permanent organization, and the attributes of effective project managers. Although Hodgetts was concerned primarily with project management in the aerospace, construction, chemical, and consumer products industries, and not with MIS projects, his inter-industry approach, the focus on individual projects and the evaluation of project techniques and relationships are relevant to the present research.

Summary

Although the literature relevant to management information systems is rather extensive, there are few reports of well conceived and structured research in the field. While prescriptions and definitions have been plentiful, they have seldom been supported by data. Numerous authors have presented their views on virtually all aspects of information systems, but these views have generally stemmed from their authors' personal experiences rather than structured research. Those

research studies which have been reported have tended to be broad-brush. They have generally represented wide-scale questionnaire and interview surveys which were aimed at overall organizational use of computers, or case studies of the impact of computer usage on organization structures and relationships.

The above comments concerning the literature relevant to MIS are not intended as criticism of what others have done. Rather, the point to be made is that in a field growing so rapidly, with so few definitive guidelines, a great deal more needs to be done. Researchers and practitioners in the MIS field must define areas to be researched, then develop well-conceived approaches to conducting such research. What has already been accomplished will be helpful, as, indeed, it has been helpful to the author in conceiving and designing the research reported in this thesis. But the overwhelming impression one is left with after reviewing the information systems literature is the great gap between what is needed and what has been accomplished.

Building on what others have said and done, the author has made an attempt to start closing that gap. The prescriptions and empirical findings of others were major contributions to the definition of the hypotheses posited and tested in the present research. The techniques others have employed have been invaluable guides to the author in designing the data collection methodology used in this research.

Nonetheless, the research conducted by the author, and reported in this thesis, represents a departure from previous research in both approach and substance. Rather than collecting a mass of data, then setting up hypotheses to be tested, the author of the present study set up the hypotheses, then developed data collection and analysis techniques to test them. As opposed to looking at overall computer usage in many organizations, or the intensive study of one or two organizations to determine what impact computer usage has had on them, the present research has focused on the MIS project. Specific, measurable criteria of project success have been defined in order that the hypotheses posited could be tested.

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PART II

HYPOTHESES, CRITERIA OF SUCCESS, AND METHODOLOGY OF THE STUDY

This part of the thesis deals with the means by which it was attempted to formulate answers to the question posed earlier:

> "What organizational and procedural factors are correlates of success with MIS projects?"

CHAPTER III

HYPOTHESES AND CRITERIA OF SUCCESS

Introduction

To assist in identifying the organizational and procedural factors related to success with MIS projects, a list of thirty-five hypotheses was developed. These hypotheses were constructed from the literature previously reviewed, from the author's personal experience, and from discussions with various professionals in the MIS field. The hypotheses provided a framework for the collection and analysis of data relevant to the purpose stated above.

In addition to the list of hypotheses, a set of criteria was developed to evaluate relative success of given MIS projects. The criteria will be taken up first, followed by a discussion of the hypotheses.

Criteria of Success

A given MIS project can be viewed from several perspectives in attempting to judge whether or not it was successful. It is necessary that the criteria selected be relevant, be as objective as possible, and at the same time be realistic in terms of ease and consistency of measurement. Four separate criteria which appear to meet these requirements are:

1. Success in terms of time. How closely did actual time spent on the project conform to the time allocated for it?

2. Success in terms of development cost. Was the project completed within the budgeted cost? If over-runs were experienced, what was the total cost as a percentage of budgeted cost?
3. Success in terms of users' evaluations. Did the completed project satisfy user requirements and expectations? Were there unanticipated problems or benefits resulting from implementing the completed project?
4. Success in terms of computer operations. Has the completed project created problems for computer operations in scheduling, set up, run time, or control?

It is believed that the above criteria are relevant operational measures of project success, and, as such, provided a suitable means of testing the hypotheses selected for evaluation.

Hypotheses

The thirty-five factors which were hypothesized to be related to MIS project success fall into the following broad categories:

1. Characteristics and competence of project personnel.
2. Project management and control techniques.

3. Organizational interaction factors.
4. Project specific factors.
5. Global factors comprising the project environment.

The hypotheses were not viewed as exhaustive nor were their assignments to categories clear cut in all cases. However, it was felt that both the hypotheses, and the categories into which they were placed, provided a suitable framework for conducting research.

The hypotheses are presented below by categories, with a brief description of what each category represents. The individual factors or hypotheses should be self-explanatory. In order to avoid redundancy in the list of hypotheses, an example of the form for each full hypothesis will be given here. The list itself will merely consist of the body of the given hypothesis in the form of a factor ostensibly related to MIS project success.

> Example: It is hypothesized that the higher the level of formal education of project personnel, the greater the likelihood of MIS project success.

Characteristics and Competence of Project Personnel (Category I)

This category should require little explanation. It is merely a grouping of those hypotheses about the competence of people who worked directly on the project. While the general statement "the more competent the personnel working on the project,

the more likely success" is something of a truism, the factors falling under competence may be debatable in certain cases. Such factors are, then, testable.

1. Coordinating ability of project leader.
2. Systems experience of project personnel.
3. Persuasiveness of project leader (as evaluated by superiors).
4. Proficiency of project personnel (as judged by superiors).
5. Low turnover of project personnel.
6. Length of experience in the organization of project personnel.
7. High formal educational level of project personnel.

Organizational Interaction Factors (Category II)

This category includes those hypotheses dealing with how the user organization interfaces with, supports, and is supported by the MIS department. It is, in short, a group of hypotheses focused on the integration of the overall organization with respect to development and utilization of management information systems.

8. Participation by operating management in design, formal approval of specifications, and continual review of project.

9. Utilization of a project team composed of MIS staff and user personnel.
10. Operating management conducts periodic management audit of MIS function. (Evaluation of effectiveness for users).
11. Organizational level of top computer executive.
12. Formal training program set up for user organization.
13. Project originated by user organization.

<u>Project Management and Control Techniques (Category III)</u>

Subsumed within this category are those hypotheses pertaining to specific methods used to plan, direct, monitor, and control a given project. This group represents many of what are frequently prescribed as "good practices" in the literature on management of the data processing function.

14. Measurable project objectives from conception of the project.
15. Formal project selection process used to determine which projects to develop.
16. Documentation standards used and enforced.
17. Use of a formalized and regular reporting structure on project progress.
18. Planning and accounting for all resources throughout project development.

19. Program maintenance and review responsibility specified for definite period after implementation.

20. Utilization of a formal time-scheduling technique such as PERT for project development.

21. Performance standards employed for analysts and programmers.

Project Specific Factors (Category IV)

This category encompasses the various factors that are unique to a given MIS project, such as the programming language used.

22. High availability of computer time for program testing.

23. High level programming language used for project.

24. Utilize existing data base versus constructing or greatly modifying one.

25. Short-term, minor project versus large, complex project.

Global Factors Making up the Project Environment (Category V)

The global category covers a rather wide range of factors as the name would imply. These are environmental variables which might be viewed as more indirect in effect than the factors under other classifications. In a sense this is a sort of omnibus category that includes the hypotheses that were

considered relevant but did not easily fit into a more specific grouping.

26. High centralization of organizational MIS activities.
27. Number of years experience for organization with computerized information systems.
28. Low turnover rate of MIS staff.
29. Combination analyst/programmers for small projects.
30. High rates of MIS staff drawn from within the organization.
31. High average income level of MIS staff.
32. Low degree of overall organizational change.
33. Separation of analysts and programmers for large projects.
34. Overall size of organization systems staff.
35. Ratio of computer hardware investment to total sales or operating budget.

Summary

This chapter has been devoted to presenting the factors which were hypothesized to be related to MIS project success and to defining specific criteria of success suitable for testing those hypotheses. Chapter IV details the methods which were used to test the hypotheses.

CHAPTER IV

METHODOLOGY OF THE STUDY

Initial Evaluation of the Hypotheses

The above list of thirty-five hypotheses would impose a considerable burden on anyone desiring to test them in field research. For this reason, it was felt advisable to try to sort out the various hypotheses into some kind of priority hierarchy. The result of such a sorting process would be a ranking of all the factors, from those viewed as most crucial to project success to those viewed as least significant. It was decided that the best means of coming up with such a priority ranking of the hypotheses was to get the opinions of professionals in the MIS field.

The opportunity for getting the opinions of MIS professionals on the importance of the various hypotheses to project success was afforded by the Founding Conference of the Society for Management Information Systems (SMIS), held at the University of Minnesota in late 1969. The decision was made to submit the hypotheses in questionnaire form to the attendees of this conference. The expected product of the completed questionnaires was to be the desired priority ranking.

Pre-questionnaire

To facilitate developing a questionnaire which, when completed, could be evaluated in such a way as to provide the

ranking by importance of the hypotheses, it was decided that a pre-questionnaire should be prepared and submitted to a group of MIS professionals in the Twin Cities area. The respondents (N=43) for the pre-questionnaire were all employed by the firms associated with the Management Information Systems Research Center of the University of Minnesota.

The objective in preparing and evaluating the pre-questionnaire was to come up with a "neutral" hypothesis which could be used as a reference or anchor point in constructing the final questionnaire to be submitted to the SMIS conference participants. This neutral hypothesis was to be the basis of comparison for each of the remaining thirty-four hypotheses. By choosing a "neutral" hypothesis as the standard for comparison, one seldom viewed as either most important or least important to MIS project success by the pre-questionnaire respondents, it was expected that the desired spread in priority rankings would be derived from the final questionnaire.

The procedure employed for the pre-questionnaire was to list the thirty-five hypotheses, or factors, disregarding any classification by categories. Opposite each hypothesis were two blanks, one under a column headed "Most Important" and the other under a column headed "Least Important". The respondent was then requested to evaluate each of the thirty-five factors as to its criticality for MIS project success, and to indicate by the numbers 1 to 7 those seven factors

considered to be most important, and those seven factors considered least important, in contributing to project success. (See Figure 1).

FIGURE 1

Pre-questionnaire

Factor	Most Important	Least Important
1) High formal educational level of project personnel	_____	_____
2) Proficiency of project personnel as judged by superiors	_____	_____

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35) Etc.	Etc.	Etc.

The returned pre-questionnaires were analyzed to determine which factor was "most neutral". That is, which factor was regarded to be of middle importance in the range of thirty-five. This factor was, of course, one that was seldom ranked as one of the seven most or seven least important in contributing to MIS project success.

SMIS Questionnaire

Analysis of the responses showed the "most neutral" factor to be: "Performance standards employed for analysts and programmers". This factor was then used to construct the

final questionnaire in the following manner. The remaining thirty-four factors were listed as before with no categorization. Opposite each factor was a Likert-type scale allowing for one of five responses to each item. At the top of each page of the questionnaire the neutral (standard) factor was printed. The respondent was then asked to rate each of the thirty-four remaining factors for importance in contributing to MIS project success by comparing it to the standard factor. The form of the response was merely a check in the chosen one of the five blanks. In addition, each respondent was provided space at the end of the questionnaire to write in any other factors which he believed important to MIS project success, but which were not included in the list of thirty-four factors to be rated (see Appendix A).

Of the roughly 250 participants in the SMIS conference, 142 returned the questionnaire. The returned questionnaires were tallied by determining the number of responses in each of the five levels for each factor. Each level was then given a numerical value as follows:

Much less	1
Somewhat less	2
About same	3
Somewhat more	4
Much more	5

Multiplying the number of responses per level by the level value, summing across all levels for a factor, then dividing by the number of responses for that factor, yielded a

numerical score for each factor. The factors were then ordered on the basis of these scores to give a ranking from most important to least important.

Results from the SMIS Questionnaire

Evaluation of the returned questionnaires resulted in the factor ranking shown in Figure 2. The scores for the individual factors ranged from 4.38 for the factor judged most important for MIS project success to 2.30 for the least important factor. In addition, as will be noted in Figure 2, the variance was calculated for each factor. These variances, ranging from .602 for the factor ranked second in importance to 1.519 for the factor ranked seventeenth, were computed to determine the relative agreement among respondents on the factors, and were not used for any purpose beyond that.

Analysis of SMIS Questionnaire Data

As was pointed out earlier, the questionnaire was constructed and administered to facilitate field study of the hypotheses. The ranking provided a means of focusing on what factors those active in the MIS field believed to be the most, the least, and of intermediate importance to project success. The next steps were to select the hypotheses to be further evaluated, and to design a means of collecting data in organizations on both the hypotheses and the criteria.

FIGURE 2

Ranking of Hypotheses

Rank		Computed Score $(\sum w_i x_i / N)$	Variance
* 1	Participation by operating management in design, formal approval of specifications and continual review of project.	4.38	.676
* 2	Measurable project objectives from conception of the project.	4.29	.602
* 3	Utilization of a project team composed of MIS staff and user personnel.	4.25	.643
4	Coordinating ability of project leader.	4.21	.620
5	Operating management conducts periodic management audit of MIS function. (Evaluation of effectiveness for users).	4.00	.970
6	Formal training program set up for user organization.	3.95	.872
* 7	Organizational level of top computer executive.	3.94	1.004
* 8	Systems experience of project personnel.	3.90	.642
9	Formal project selection process used to determine which projects to develop.	3.88	1.058
10	Persuasiveness of project leader (superior's evaluation).	3.84	.856
11	Proficiency of project personnel (as judged by superiors).	3.79	.780
*12	Documentation standards used and enforced.	3.74	.942
*13	Use of a formalized and regular reporting structure on project progress.	3.68	.686
*14	Low turnover of <u>project</u> personnel.	3.56	.862

* Hypotheses selected for further study.

FIGURE 2 (Cont.)

Rank		Computed Score	Variance
15	Planning and accounting for all resources throughout project development.	3.50	.968
*16	Source of origination of project (MIS staff or user).	3.48	1.237
*17	High centralization or organizational MIS activities.	3.46	1.519
18	Program maintenance and review responsibility specified for definite period after implementation.	3.45	1.073
19	Number of years experience for organization with computerized information systems.	3.43	.934
*20	Length of experience in the organization of project personnel.	3.32	1.051
21	Utilization of a formal time-scheduling technique such as PERT for project development.	3.25	1.056
22	High availability of computer time for program testing.	3.04	1.272
*23	High level programming language used for project.	3.00	1.059
24	Utilize existing data base versus constructing or greatly modifying one.	2.99	1.511
25	Low turnover rate of MIS staff.	2.91	1.029
26	Short-term, minor project versus large, complex project.	2.89	1.437
27	Combination analyst/programmer for small projects.	2.86	1.191

* Hypotheses selected for further study.

FIGURE 2 (Cont.)

Rank		Computed Score	Variance
28	High rates of MIS staff drawn from within the organization.	2.81	1.104
29	High average income level of MIS staff.	2.77	.750
30	Low degree of overall organizational change.	2.72	1.263
*31	High formal educational level of project personnel.	2.71	1.109
*32	Separation of analysts and programmers for large projects.	2.51	1.274
*33	Overall size of organization systems staff.	2.50	1.207
*34	Ratio of computer hardware investment to total sales or operating budget.	2.30	1.188

* Hypotheses selected for further study.

Two approaches were used in selecting the hypotheses for further evaluation. First, it was desired that about three factors be evaluated from the top, middle, and bottom of the ranked listing. Based on this, and the relative ease of collecting data on each of the factors, the following factors were tentatively selected for evaluation (numbers refer to ranks in Figure 2):

Top	1, 2, 3
Middle	14, 16, 17
Bottom	31, 32, 33, 34

Second, a factor analysis was performed on the questionnaire data using the principal components method (see Guilford, 1954; Harman, 1965). The reason for this was to determine if items on the questionnaire represented certain basic dimensions or underlying factors. If present, such underlying factors could then be used as a guide in selecting individual hypotheses from the ranked list for evaluation.

The factor analysis yielded eleven factors accounting for 65.9% of the variance. However, most of these factors accounted for a small part of the overall variance, and/or only one or two questionnaire items loaded to any appreciable extent on a given factor. The factor accounting for the largest amount of the variance (9.475%) represented

essentially those items that were ranked high on the questionnaire (items 1, 2, 3, 5, 6, and 9 in Figure 2). The factor accounting for the second largest amount of the variance (9.456%) represented essentially those questionnaire items ranked low (items 17, 28, 29, 31, 32, 33 and 34 in Figure 2). A third factor, accounting for 6.44% of the variance, had three items loading very high on it (items 13, 15 and 21 in Figure 2), and represented what could be called "project control". The other eight factors were judged not to be meaningful for the purposes here, either because they accounted for such a small part of the variance or because only one or two items loaded on them to any extent.

It was apparent from the factor analysis that the high ranked and low ranked items, comprising the first two factors, were well represented in the preliminary list of ten hypotheses selected for further evaluation. However, the project control factor was not represented among those ten. Therefore, item 13 from the ranked list (Figure 2) was added to the ten hypotheses previously selected for further evaluation.

Besides the above eleven hypotheses, five more were selected to be further evaluated. These were items 7, 8, 12, 20, and 21 from the ranked list of hypotheses (Figure 2). The rationale for including these additional hypotheses was

(1) ease of collecting data concerning them; merely being in an organization would allow getting data on the hypotheses at virtually no extra cost, and (2) personal interest in the hypotheses because of related research currently going on or because of emphasis in the literature.

As was noted earlier, space was provided for each respondent to write in any factors he felt important to MIS project success. All write-in responses were reviewed, but no new hypothesis was deemed necessary from this review. In most cases, the respondents merely restated in a different form one of the hypotheses in the list rated. In a few cases the write-in comments were not closely related to the hypotheses rated; however, the incidence of one or two comments on a subject was not viewed as justification for creating a new hypothesis.

In summary, the result of the questionnaire analysis was the selection of those sixteen hypotheses identified by an asterisk (*) in Figure 2 to be evaluated by field study.

Data Collection in the Field

It was believed that the best means of collecting data to test the selected hypotheses was through interviewing key persons involved in developing, or using the products of,

MIS projects in several organizations in several industries. This approach was to comprise a "descriptive" study, using the terms of Selltiz et al (1967). That is, the emphasis was on finding out if given variables were associated, in this case the hypotheses and the criteria of project success.

With a view to the above objectives, a questionnaire to be used by the researcher in structured interviews was developed. This questionnaire (see Appendix B) was aimed at collecting several kinds of data and consisted of several parts. First, the kinds of data collected with the questionnaire can be described as independent variable data, dependent variable data, and moderator variable data. The independent variables were the hypotheses selected, as outlined above; the dependent variables were the criteria discussed earlier; and the moderator variables represented various organizational or procedural factors which might have influenced or moderated the relationships among the independent and dependent variables.

The parts of the questionnaire reflect who was expected to answer certain kinds of questions about a project in the organization. Thus, certain questions about the organization itself were to be answered by the manager of the MIS function. The questions specifically related to the project were to be asked of the project leader, and the questions concerning user perceptions of participation and satisfaction with the products

of the project were to be directed to user management personnel.[1]

It was decided that twenty MIS projects, drawn from ten separate organizations, would constitute an adequate sample for the type of research to be conducted. This would represent two projects in each of the ten organizations. It was further decided that of the two projects in each organization, one of them should be viewed as relatively successful, and one relatively unsuccessful, by personnel in the information systems area of the organization.

The general guidelines for selecting projects for study were specified as follows:

1. Must be a MIS project as defined in Chapter I; not a data processing application with no MIS implications.
2. At least two people worked full time in developing the project; the project required at least three elapsed months to develop.
3. The project was completed and implemented within the last 6-24 months.

The reason for guideline 2 above was to preclude studying very small projects which were completed by one person over a brief time, such as a simple report generation application from

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[1] The following references were used in developing the questionnaire for conducting interviews: Cannell & Kahn, 1953; Edwards & Kenney, 1946; Festinger & Katz, 1953; Payne, 1951; Selltiz et al, 1967; Torgerson, 1953; Whitlock, 1963.

an existing file of data. The reasons for guideline 3 were to avoid projects which had been completed for so long that those involved were not available for interview, or, if available, their recollections were too fuzzy to be anywhere near accurate; and to avoid projects which had been completed so recently that there was inadequate user experience with the products to allow fair evaluation.

Pretest of Interview Instrument

It was next decided that a pretest of the questionnaire should be made prior to actually selecting a sample and making contacts for the full study. The objectives of the pretest were to determine if data of the types wanted could be gathered, and, if so, were the questionnaire and associated structured interview effective and efficient means to collect these data.

Accordingly, to satisfy these objectives, and to obtain estimates of how long the data collection would take for each organization in the sample, a pretest of the questionnaire and interview technique was conducted during the week of 4 May 1970, in a Twin Cities financial institution. Based on the pretest, it was concluded that the data collection techniques planned were feasible, and would provide the data desired. However, certain very minor changes to the questionnaire appeared desirable as a result of the pretest experience. For the most part, the changes merely involved revisions of wording in questions which had caused some confusion among pretest

respondents. Two questions were dropped completely from the questionnaire as it was apparent they were redundant. These two questions elicited essentially the same information from respondents as two other questions which were left in the questionnaire. Three questions were added to the questionnaire, and two were modified substantially, in order that project leaders and users would be asked identical questions concerning user participation and implementation problems. None of these changes altered the substance of the questionnaire to any appreciable extent, and were, primarily, corrections for oversights brought out by the pretest. After revising the questionnaire, work began on selecting the organization sample to be used in the full field study.

Organization Sample Selection

As was stated at an earlier point, it was desired that the ten organizations comprising the study sample represent different industries to the greatest extent possible. This objective for selecting an organization sample was constrained by the fact that it was also desired that those organizations in the sample be Associates of the Management Information Systems Research Center (MISRC) at the University of Minnesota. However, this constraint was not a very serious one in that the Associate firms do represent a wide cross-section of industry types in the Twin Cities area.

With a view to the above requirements, a preliminary list of ten firms was prepared. Each of these ten firms was then sent a letter from the Associate Director of the MISRC, indicating the nature of the research to be conducted, the background of the researcher, and a request that the firm participate in the research (Appendix C). Within one to two weeks from the time the letter went out, the researcher contacted the Associate representative of each firm by telephone to request an appointment for the purpose of discussing the study and getting agreement from the firm to participate.

During the last two weeks of July, 1970, each of the ten firms originally selected was visited by the researcher. These visits generally lasted about thirty minutes, during which time the researcher described what the study was to consist of, the kinds of data to be collected, and the types of people in the organization who would be involved if the firm agreed to participate. Additionally, each Associate representative with whom the researcher visited was given a brief written résumé of the proposed research, which included the estimated duration of each interview to be conducted and the total time commitment by the organization (Appendix D).

Of the initial ten organizations contacted, all but one agreed to participate in the study. The one exception was an organization which had begun exploring MIS applications very recently, and felt, therefore, that there would not be

any projects for study in the organization which staisfied the researcher's project selection specifications. However, to offset this organization's not participating in the study, one of the Associate representatives visited desired that two separate divisions of his organization be included in the study. The researcher agreed to this after satisfying himself that, for all practical purposes, the two highly autonomous divisions of this very large and diversified corporation were separate and independent with respect to the factors relevant to the study.

Having gotten agreement to participate in the study from those organizations selected for the sample, a schedule was prepared for actual data collection. This schedule, covering the period from early October to mid-December, 1970, allowed at least three days for collecting data in each organization. Each organization was again contacted by telephone to arrange the dates for interviewing in the organization. The only appointment made at this time was with the director of the information systems function or other individual(s) whom had been designated by the Associate representative to coordinate data collection in the organization.

Data Collection Procedures

The data collection procedures followed in each organization which participated in the study were as follows:

1. An initial meeting with the manager of the information systems function and/or his designated representatives was opened by explaining precisely what data were to be collected, and from whom, after a general description of the research study had been provided. Next, the organization representatives were asked to suggest projects for study which met the project selection specifications described earlier in this chapter. This proved to be a more time consuming task than expected, and, in some cases, required as long as three hours rather than the thirty minutes estimated from the pretest experience. Those two projects which best satisfied the selection specifications were chosen for study. The organization representatives were then requested by the researcher to arrange appointments with the project leaders of the two projects selected. Finally, the manager of information systems, or his representative, was asked to complete pages 1-3 of the questionnaire. This was the only part of the questionnaire which was not completed during

interviews with the researcher. However, on several occasions the researcher did assist the respondents for pages 1-3 by clarifying points that were confusing, or in making certain that the respondents interpreted the questions as the researcher intended.

2. The meeting with the project leader was opened with a brief description of the nature of the study and the data to be collected, and with assurances to the project leader that all of his responses would be held in confidence by the researcher. The remainder of the 1½ to 3 hours spent with the project leader was devoted to completing the appropriate portions of the questionnaire. The respondent was given a copy of the questionnaire to read as the researcher asked the questions.

   Upon completion of his portion of the questionnaire, the project leader was requested to arrange appointments with at least two managers in the area(s) which received the products of the project. For this purpose, a staff analyst or similar person was considered to be a manager. In general, if a user was involved in making planning and/or control decisions in a functional

area of responsibility, he was considered a manager whether he had any subordinates or not. Finally, the project leader was requested to arrange an appointment with the computer operations manager, or other knowledgeable individual in the computer operations function who could answer those questions pertaining to computer operations for the project.

3. The meeting with each user was opened in exactly the same manner as the meeting with the project leader. After the preliminary comments by the researcher about the study, the remainder of the fifteen to thirty minutes spent with the user was devoted to the completion of the relevant portions of the questionnaire. As with the project leader, the user was provided a blank questionnaire to read as the researcher asked the questions.

4. The same preliminary explanations on the nature of the study, and so forth, were provided to the computer operations management. In most cases, the computer operations data for both projects in an organization were collected in one interview. This interview generally lasted from ten to fifteen minutes.

Steps 2 and 3 of the above procedure were repeated for the second project studied in the organization.

Data Analysis Procedures

After all the data had been collected in all ten organizations in the sample, the interview forms were reviewed and coded by the researcher. Since the questionnaire was originally developed to facilitate coding and conversion of the data to punched card form, this was a relatively easy task.

Several methods of data analysis were considered, but it was decided that Kendall's (1962) tau statistic provided the best measure available of relationships among the variables for the following reasons:[1]

1. The tau statistic is robust and relatively powerful in dealing with ranked data containing ties among ranks.
2. Being a measure of relationship among ordinal variables, there are no assumptions concerning distribution of the raw data for the tau statistic.
3. The S statistic, which is actually the numerator of the tau statistic, and is a measure of the agreement or disagreement between a pair of rankings, is distributed approximately normally

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[1] For discussions of the tau statistic, its distribution under various conditions, and corrections for continuity, see Burr, 1960; Goodman and Kruskal, 1954; Höffding, 1947; Kendall, 1947; 1962; Sillitto, 1947; Somers, 1962; and Whitfield, 1947.

for N $\geq$ 9. The S statistic can, therefore, be converted to a normal deviate, Z(s), after computing the variance of S. This normal deviate can then be tested, using the normal probability table, to ascertain the significance level of the relationship between two rankings.

4. Since the data collected could be arranged in naturally ordered bivariate tables, the computation of tau, S, and Z(s) could be accomplished quite easily using the UMST (1969) programs available for the University of Minnesota's CDC 6600 computer system.

The first step taken in analyzing the data collected was to prepare a descriptive profile of the sample. This descriptive profile was broken into two parts: descriptive statistics on the organizations in the sample, and descriptive statistics on the projects. These descriptive statistics consisted of means, medians, and ranges on those variables which were amenable to such treatment, and distributions of scores on the variables which were not. These descriptive statistics on the organizations and the projects are presented in Chapter 5.

The second step in analyzing the data was to compute the tau statistics for relationships among the variable rankings. This step, in turn, was divided into three substeps.

First, it was necessary to determine whether or not those variables which were originally intended to be composites of several separate items were, in fact, valid composites representing the same factor, or were, in reality, separate factors which should not be aggregated. The variables in question were User Participation-PL (Var. 41), User Participation-User (Var. 46), User Satisfaction-User (Var. 54), project leader's perception of success, and operations success. To make this determination, Pearson product-moment correlation coefficients were computed for all of those separate items comprising a supposed aggregate factor. This computation was accomplished with computer program UMST 530. If any item within a supposed composite factor was not correlated at least .50 with every other item in that composite factor, that item was considered to be a separate measure and dropped from the composite factor. It was found that Variables 41, 46, and 54 did, in fact, have items which were intercorrelated at least .50, and, therefore, were acceptable as composite measures of the factors in question. However, the intercorrelations of separate items in the assumed composite variables representing the project leader's perception of success and computer operations success were so low as to preclude their being considered composite factors. Consequently, computer operations success and the project leader's perception of success were treated in all further analysis as two separate variables (59 and 60), and

four separate variables (55-58), respectively. (See Appendix E for descriptions of all variables used and their scoring.)

Next, in order to determine roughly which variable rankings were related enough to warrant further investigation of the relationships, UMST 540 was used to provide a tau statistic for every possible cross-classification among the 61 variables in the study. The tau statistic computed by UMST 540 was based on Siegel's (1956) formula for tau-B, and gave an inflated normal deviate where there were ties present in the rankings. This inflated normal deviate resulted from not making any correction for continuity prior to computing the normal deviate. However, the computation with UMST 540 was relatively simple and fast, and provided an excellent means for identifying those variable relationships which should be explored further in the last substep.

Finally, UMST 590 was used to derive tau, S, and Z(s) statistics for all criterion variables cross-classified against each other, all hypothesis variables cross-classified against all criterion variables, and all other relationships which were indicated as possibly significant from the previous run based on Siegel's formula for tau-B. UMST 590 computations are based on Kendall's (1962) formulas for tau-B, tau-C, S, the variance of S, and the normal deviate of S. (See Appendix F for these computing formulas.)

PART III

RESULTS OF THE STUDY

Part III contains the substance of the research study. It is divided into three chapters. Chapter V presents descriptive data on the organizations in the sample and on the projects studied. These descriptive data consist of means, medians, and ranges where appropriate, and of distributions of responses by category where they are appropriate.

Chapters VI and VII present the results of the statistical analysis of the sample data. The primary means of analysis was, as discussed in Chapter IV, the determination of association among variables using Kendall's rank correlation statistic, tau. The tables of association are included with the text to facilitate reader reference.

CHAPTER V

DESCRIPTION OF THE STUDY SAMPLE

Organizations in the Sample

The ten organizations which participated in the study were all located in the Twin Cities area. Two of the organizations were highly autonomous divisions of a large, multi-business corporation. The remaining eight organizations were completely unrelated.

The ten organizations were categorized into the following industry groupings:

1. Manufacturing. 5
   a. Consumer products using continuous process production technology. 3
   b. Industrial products using assembly line/mass production technology 2
2. Non-manufacturing. 5
   a. Wholesale, retail trade. 1
   b. Transportation 1
   c. Finance. 1
   d. Utility. 1
   e. Commodity merchandising and processing 1

Measures of Organization Size

The organization sample represented considerable range in terms of relative organization size. This fact is reflected

in Table 1, which shows the mean, median, and range for four measures of organization size.

TABLE 1

Measures of Organization Size[1]

	Mean	Median	Range
Assets (Var. 1) thousands (7 organizations only)	$593,286	$170,000	$ 60,000-$2,875,000
Sales (Var. 2) thousands (8 organizations only)	$647,000	$491,000	$ 76,000-$2,600,000
Employees (Var. 3)	9,931	6,100	560-47,900
Customers (Var. 4) (8 organizations only)	147,693	27,500	500-450,000

[1]Throughout Part III, the variable number is presented whenever a variable is discussed or entered in a table. This has been done to facilitate reader reference to Appendix E where all of the variables in the study are fully described. No particular significance should be attached to the variable numbers themselves, however. The numbers were assigned by the researcher in essentially the order the variables appeared in the study questionnaire (Appendix B).

Other Relevant Organization Attributes

Several other attributes of the organization sample besides organization size are relevant to the present study. Included in this category are the reported degree of organizational change over the last three years; the reported degree of centralization of the organization's MIS activities; the

organizational location of the manager of the information systems function; the organization's hardware investment and costs; and the size of the systems and programming staff. The data for all of these attributes are shown in Tables 2-4.

TABLE 2

Organization Change, Centralization, and Level of the Information Systems Manager

Organizational Attributes	Number of Organizations
• Organization Change over Last Three Years (Var.5):	
Little or no change	5
Minor changes	1
Considerable change	4
• Centralization of Organization MIS Activities (Var. 8):	
All design, analysis, and programming performed by corporate MIS staff regardless of origin of project.	8
Exactly as above, except that small operations research group developed some of its own projects.	2
• Level of Information Systems Manager (Var. 9):	
Number of hierarchical levels between manager directly responsible for information systems function and the top operating executive:	
0 Levels	3
1 Level	5
2 Levels	2
• Immediate Superior of Manager of Information Systems:	
Top operating executive	3
Administrative vice-president (or similar position)	3
Controller	3
Market research director	1

TABLE 3

Hardware Investment and Costs

	Mean	Median	Range
Hardware Investment/Sales (Var. 6)	.94%	.90%	.10%-2.1%
Hardware Expense/Budget (Var. 7)	35%	35%	13%-50%

TABLE 4

Size of Systems and Programming Staff

	Mean	Median	Range
Number in Systems and Programming (Var. 10)	50	35	7-156
Systems Staff/Total Employees (Var. 61)	1.31%	.52%	.25%-8.2%

Projects in the Sample

This section of Chapter V deals with the descriptive findings relative to the twenty projects themselves. The variables to be discussed include those pertaining to project scope and size, project personnel, project procedural features, and project success.

Before taking up the specific variables for which data were collected, several general points concerning the project sample are in order. First, it is reiterated that only projects which met the criterion of being MIS projects were included in the sample. Projects which were merely data processing applications with no management information spinoffs were rejected. In some instances the satisfaction of this criterion severely narrowed the range of projects available for study. In fact, in some organizations it was only after considerable probing that valid MIS projects could be identified. This situation led to accepting projects for study which did not fall within the desired time and size parameters given in Chapter IV. Specifically, the following deviations were made from the criteria for project selection:

1. It was desired that all projects in the sample had had at least two people who worked primarily on the project during its active development periods. Eighteen of the projects met this requirement, but two did not. Two projects

were developed entirely by one person. However, they were of such scope that they were considered to be valid components of the sample.

2. It was desired that all projects had been completed between six and twenty-four months prior to the time of the study. This proved to be the most difficult requirement to satisfy, in that only fourteen projects were completed between November, 1968, and July, 1970. Three projects were completed prior to November, 1968, the earliest of which was implemented in September, 1967. This means that a little more than three years had elapsed between the time the project was completed and the time the data were collected. While the period of recollection was thus over a year longer than the maximum recollection period desired, it was impossible to estimate how much the data were biased by increased forgetting of the specifics of the project. This same observation holds for all of the projects beyond the twenty-four month limit, and, indeed, for all of

the projects in the sample, excepting the very recent ones.

Three projects were completed after July, 1970, the most recent of which was implemented in October, 1970. The primary consideration with such recent projects was, of course, whether or not the users had had adequate time to evaluate the results of the projects. The researcher was satisfied that two of the projects completed since July, 1970, did have an adequate experience base for fair evaluation. One of these projects, completed in September, resulted in a daily output which had provided ample opportunity for shakedown and appraisal. The other project, completed in August, had been evolving over a period of twelve months, with very close interplay between the users and the systems staff. In effect, this project was not considered completed until the users had indicated satisfaction with the products after several months of evaluating alternative outputs. The third, and most recent project, completed in October, 1970, was studied in early December. To check on

the users' perceptions of the project after two additional months experience, a follow-up was made with the users in early February, 1971. Although still two months short of the desired six months minimum, there is no reason to suspect bias enough to warrant not including the project in the sample.

General Types of Projects

As previously stated, all of the projects studied were management information system projects; that is, outputs were generated for a manager at some level which were inputs to his decision-making process. This general classification between MIS projects and data processing projects was further broken down into the subcategory of best fit. The subcategories and numbers of projects in each are shown in Table 5.

Origin of Projects and Nature of Objectives

Of the twenty projects studied, 65% were initiated by user managements. This would seem to indicate a desire on the part of functional managers to utilize the computer as an aid in carrying out their decision-making responsibilities. However, the reported objectives in initiating projects did not always seem to be as clear and specific as they might have been. These observations are based on the distributions of project origins and project objectives shown in Table 6.

TABLE 5

Types of MIS Projects Studied

Types of MIS Projects	Number of Projects of Type
1. Models: projects involving management science techniques such as simulation, mathematical programming, or forecasting; generally projects aimed at providing inputs to planning processes	4
2. Data processing spinoffs: projects which evolved from operational control systems at the lower levels of the organization; generally spinoffs from accounting and logistics systems, and aimed at providing input to control processes through monitoring, triggered, or demand reports (see Blumenthal, 1969, p. 51).	9
3. Data collection and analysis: projects which were developed from the ground up with specific uses and requirements; generally involved setting up means to collect desired information, creating the necessary data base, and developing analytical routines to manipulate the data base; these projects aimed at providing inputs to both planning and control processes; an example of such a project would be a marketing intelligence system	7

TABLE 6

Project Origins and Objectives

	Number of Projects
Origin of Project (Var. 11)	
User.	13
Top level management.	3
Information systems staff	4
Project Objectives (Var. 12)	
Specific, measurable, written objectives. . .	5
Specific, non-measurable, written objectives.	6
General, clear, written objectives.	2
General, unwritten objectives	3
Rather vague objectives	4

Project Scope and Size

The following variables relate to the size and scope of the projects in the sample:

Complexity - (Var. 13)

There was no objective measure of comparative complexity of projects in the sample. The ratings of project complexity were entirely relative to the individual project leaders and the systems environments in their organizations. For this reason, the distribution given below is not the distribution of complexity of all sample projects based on some objective scale applied to all projects; rather, it is a distribution of

the ratings of complexity assigned by each project leader relative to his own experience:

Highly complex 3

Above average complexity . . .5

Average complexity 8

Below average complexity . . .2

Very low complexity. 2

Size and composition of project staffs

Table 7 provides a breakdown of the composition and size of project staffs for the projects in the sample:

TABLE 7

Composition of Project Staffs

	Mean	Median	Range
Number on Project (Var. 17)	5.0	4	1-12
Number of Analysts (Var. 18)	1.5	1	1-3
Number of Programmers (Var. 19)	2.5	2	1-8
Number of Users - N=13 (Var. 20)	1.8	2	1-3

Outside consultants used on three projects

Time spent on projects

Table 8 contains data on the elapsed time and the man months spent on the projects in the sample:

TABLE 8

Time Spent on Projects

	Mean	Median	Range
Elapsed Months (Var. 21)	12.1	10.5	2-48
Man Months (Var. 22)	22.0	10.0	4-87

Attributes of Project Personnel

The following variables relate to the education, systems experience, and organization experience of those who worked directly on the projects in the sample:

Systems experience

Table 9 contains data on four measures of the systems experience of those who worked directly on the projectsstudied:

TABLE 9

Systems Experience of Project Personnel

	Mean	Median	Range
Systems Experience of Project Leader--months (Var. 24)	66.2	43.5	0-300
Mean Systems Experience of Project Personnel Including Users--months (Var. 25)	47.3	28.5	8-180
Mean Systems Experience of Project Personnel from MIS Staff Only--months (Var. 26)	52.5	37.5	11-180
Two or More Years Systems Experience--proportion (Var. 27)	58%	50%	0-100%

It should be noted that the values given in Table 9 for Variables 25, 26, and 27 are not those for all project personnel in the sample. Rather, they are the values derived from the means or proportions that Variables 25, 26, and 27 represented for each project. Thus, 47.3 months is the mean of twenty project means, not the mean systems experience for all individuals who worked on projects in the sample.

Impact of systems experience - (Var. 28)

With respect to the impact of systems experience on project success, project leaders generally indicated that such experience was a contribution to project success, and lack of systems experience hindered success somewhat. However, as the following distribution of Variable 28 shows, 25% of the project leaders felt that prior systems experience was of no importance one way or the other to project success:

Experience critical to success	4
Experience contributed somewhat to success.	8
Experience of no importance.	5
Lack of experience of some staff members detrimental	3

Education

Table 10 contains data on three measures of the educational levels of those who worked directly

on the projects studied:

TABLE 10

Formal Education of Project Personnel

		Mean	Median	Range
College Degree - proportion	(Var. 30)	65%	75%	0-100%
Two Years College - proportion	(Var. 31)	79%	87%	33-100%
Mean Years Formal Education	(Var. 32)	15.3	15.3	13-18

As with systems experience, it should be noted that the above values are derived from project statistics, not individual measures.

Organization experience

Table 11 contains data on two measures of the experience project personnel had in their respective organizations at the beginning of the projects studied.

TABLE 11

Organization Experience of Project Personnel

		Mean	Median	Range
Mean Years Organization Experience	(Var.33)	6.75	6.75	1.5-20.0
Two or More Years Organization Experience - proportion	(Var.34)	69%	69%	25-100%

As with systems experience and education, the above values are derived from project statistics, not individual measures.

Turnover - (Var. 29)

Of the twenty projects in the sample, only three experienced any turnover among the project staff. Two of these projects had a turnover rate of 50%, while the third project's turnover rate was 67%. For the three projects which experienced staff turnover, the project leader's appraisal of the impact of this turnover on project success was distributed as follows:

Very detrimental 1

Somewhat detrimental 1

Contributed to success 1

Procedural and Organizational Attributes of Projects

Tables 12 and 13 contain breakdowns of the study sample according to several organizational and procedural attributes of the projects. In addition to the information in these tables, several amplifying or explanatory comments concerning the attributes shown are in order.

As can be seen from Table 12, thirteen of the projects studied (65%) were developed by project teams comprised of user representatives working with information systems staffs. Of those thirteen, two project teams had user representatives

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As can be seen from Table 12, thirteen of the projects studied (65%) were developed by project teams comprised of user representatives working with information systems staffs. Of those thirteen, two project teams had user representatives

assigned full time during the analysis and design phases; the remaining eleven project teams had user representatives working on the projects on a part-time basis. Further, for eleven of the thirteen projects where a team was utilized, the user representatives who participated on the teams were also responsible for implementing the completed projects in their respective departments, and for maintaining liaison with the information systems staffs after implementation. For the other two projects, team participants during development were not the ones responsible for implementation and continuing liaison.

For the thirteen projects which were developed by teams, the mean value for the proportion of total project man-months accounted for by user personnel (Var. 15) was 18%; the median value was 18.5%; and the range was 4-51%.

Finally, project leaders generally felt that user representatives on project teams made valuable contributions to project success. Nine of the project leaders who headed teams appraised user member contributions as very great, as critical to project success. The other four project leaders felt that user members made some contributions, and that the projects would not have turned out as well as they did without the users.

With respect to project documentation, formal standards for documentation were considered to exist even if such standards were applicable to only the programming phase of a

project. It should also be pointed out that the quality of project documentation was not measured against any universal objective standard or scale. Rather, the documentation quality distribution shown in Table 12 reflects the appraisals of individual project leaders as to how good they thought the project documentation was for their respective projects.

The degree of user participation in the analysis and design of each project was appraised by both user personnel and the project leader. The amount of agreement between those appraisals will be taken up in a subsequent chapter. However, it is worth noting at this point that there was a tendency for fairly high levels of user participation in the projects studied, whether viewed from the users' side or the project leader's perspective. This observation is supported by the statistics in Table 13.

TABLE 12

Project Procedural and Organizational Attributes

	Number of Projects
Project Team (Var. 14):	
Yes	13
No	7
Combination Analyst/Programmer (Var. 23):	
Combination	9
Separate	11
Documentation Standards (Var. 35):	
Yes	16
No	4

TABLE 12 (Cont.)

Project Procedural and Organizational Attributes

	Number of Projects
Quality of Documentation (Var. 36):	
High quality.	6
Adequate.	8
Somewhat inadequate	5
Low quality	1
Project Control (Var. 42):	
Formal or informal report of progress against plan required of project staff at least monthly.	11
No regular progress reporting required of project staff.	9
Programming Language (Var. 43):	
COBOL	15
FORTRAN	2
Assembly.	3
Generalized Software Problems (Var. 44):	
No problems	15
Minor problems.	4
Major problems.	1

TABLE 13

User Participation

	Mean	Median	Range
User Participation-PL (Var. 41) possible range: 3-15	11.5	12.5	4-15
User Participation-User (Var. 46) possible range: 40-200	153	162	83-200

Project Success

It was stated in Chapter III that four criteria of project success were defined for the study: time, cost, user satisfaction, and computer operations problems. The performance of the projects on each of these criteria is shown in Table 14. In addition to what is shown in the table, the following comments concerning the criteria are relevant:

Time

Of the twenty projects, six were completed within the times estimated; the remaining fourteen exceeded their time estimates by varying amounts up to 900%. Of the six projects which were completed on time, overtime was required to do so for three of them. One of the three on-time projects which had considerable overtime also had substantial programmer resources added to the staff to meet the time deadline.

Cost

An interesting finding regarding project cost was that nine of the twenty projects in the sample had no cost budget. No cost estimates were ever made, or at least ever recorded or referred to later, for nearly half of the projects studied. Since it was impossible to determine if a project was completed within its

cost budget if such a budget never existed, the cost data for these projects were estimated, based on man-months data and estimates of computer test time. This seemed to be a reasonable approximation to project cost, since by far the largest part of project cost was accounted for by manpower cost, which, in turn, was a direct function of man-months spent on a project. Where program test time was determined, through discussions with the project leader, to be of any consequence in the total project cost, a factor for computer cost was included in the cost estimates. Using, then, the best estimates that could be devised for project cost data, it was found that only two of twenty projects were completed within their cost budgets. The remaining eighteen projects exceeded their cost estimates by varying amounts up to 500%.

<u>User satisfaction</u>

Since five separate factors were aggregated together to form the measure of user satisfaction (Var. 54), the range of possible values for this measure was 50-250, with 50 representing extremely low user satisfaction and 250

representing extremely high user satisfaction. As the statistics in Table 14 indicate, a fairly high level of user satisfaction existed for most projects in the sample. If the sum of the middle of the five possible ratings on the scale for each of the five factors was taken as an "average" level of user satisfaction, the resulting "average" value would be 150. It can be seen that both measures of central tendency shown in Table 14 for the actual sample well exceeded that hypothetical value.

Computer operations problems

In general, the projects in the sample were successful in terms of not creating problems in the computer operations function. With a five point scale, ranging from very serious problems at the low end to no problems at the high end, a hypothetical average would have fallen in the middle of the scale, or at a value of 3, which represents moderate problems for computer operations. However, the mean value for computer operations problems (Var. 59) in the sample was 3.95, and there was no project in the sample rated below 3 on the scale.

The distribution of the ratings on this criterion was as follows:

No problems. 5

Very minor problems. . . 9

Moderate problems. . . . 6

TABLE 14

Project Success

		Mean	Median	Range
Actual Time/Estimated Time	(Var. 48)	209.6%	139.5%	75-900%
Actual Cost/Estimated Cost	(Var. 51)	194.7%	151.5%	82-500%
User Satisfaction-User (possible range: 50-250)	(Var. 54)	175.8	192.5	80-220
Computer Operations Problems (possible range: 1-5)	(Var. 59)	3.95	4.0	3-5

Summary

In summary, it can be seen from a review of the descriptive information presented in this chapter that the study sample represented considerable diversity among organizations and projects. The organizations in the sample were from varied industries; they represented a wide range in terms of size; and they differed in varying degrees on several other organizational attributes relevant to the study. With respect to the individual projects studied, there were three general

types of MIS projects: models; projects that were spinoffs from data processing applications; and projects which were developed from the ground up to provide data collection and analysis capability in specified planning and control areas. The twenty projects represented substantial diversity in terms of size and scope; procedural and organizational attributes; and, finally, performance on the criteria of success.

CHAPTER VI

TESTS OF HYPOTHESES

Introduction

This chapter and the one which follows are devoted to presenting the results of the analysis of the sample data. As indicated in Chapter IV, the primary form of statistical analysis was the computation of Kendall's rank correlation statistic, tau. This measure of the degree of relationship between the rankings of two variables was tested for statistical significance in all cases.

The number of possible cross-classifications, and resultant relationship statistics, with 61 variables was 3660. To avoid burdening the reader with all of these statistics, and to conserve computation time and cost, the steps discussed in Chapter IV were followed. The results of the data analysis have been further limited here by presenting only the following:

1. Relationships among criterion variables; all tau statistics presented regardless of significance levels.
2. Relationships of hypothesis variables to each of the four criteria of success; all tau statistics presented regardless of significance levels.
3. Relationships of criterion variables to other non-hypothesis variables which were

significant at the .10 level or beyond.

4. Relationships of hypothesis variables to other non-criterion variables which were significant at the .10 level or beyond.

5. Other relationships among variables felt by the researcher to be relevant to the study, which contributed to understanding of the overall conclusions drawn, and which were significant at the .10 level or beyond. This last category is presented in Chapter VII.

All tests for the significance of the relationship between the rankings of two variables were made with the .10 level as the cutoff. Any relationship with a probability of chance occurrence greater than .10 was not considered to be significant. Since the direction of expected relationship was stated in only those cases where a hypothesis was tested (category 2 above), all significance tests were two-tailed tests except those involving the relationship of a hypothesis variable to a criterion variable.

Relationships Among Criterion Variables

At the time this study was conceived, it was assumed that the four criteria to be used were independent. Otherwise, all four would not have been included in the study. However,

no hypothesis to this effect was set up. For this reason, all tests of relationship among the four criteria are two-tailed tests.

It can be seen from Table 15 that there were no relationships among any of the criteria which reached significance at the .10 level. This supports the assumption of independence among the four criteria used in the study.

TABLE 15

Relationships among Criterion Variables[1]

	Cost (Var. 51)			User Satisfaction (Var. 54)			Operational Problems (Var. 59)		
	Tau	Z(s)	P(Z)[2]	Tau	Z(s)	P(Z)[2]	Tau	Z(s)	P(Z)[2]
Time (Var. 48)	.257	1.534	.124	.064	.359	.720	.067	.281	.778
Cost (Var. 51)				.091	.522	.604	-.030	.105	.916
User Satisfaction (Var. 54)							.345	1.582	.104

[1]All values shown for tau in all tables are tau-C unless a given value is prefixed by B, in which case that value is tau-B. See Appendix F for differences in computation of tau-B and tau-C.

[2]P(Z) value shown includes both tails of the normal distribution. For all tables, the value shown under P(Z) represents the chance probability, one-tailed or two-tailed, as indicated, of having a normal deviate for the S statistic as large as the one shown under Z(s).

The strongest relationship between any two criterion variables was the one between user satisfaction-user (Var. 54) and operations problems (Var. 59), with a tau of .345. This relationship had a chance probability of .104, which almost reached the .10 cutoff level established. Although not significant based on the arbitrary .10 cutoff used in the study, there did appear to be a meaningful relationship between how satisfied the user was and how successfully the project had been implemented by computer operations. Where there were substantial problems for computer operations in running particular programs, or in meeting certain schedules, there also tended to be lower user satisfaction. It cannot be assumed that computer operations difficulties caused user dissatisfaction, although this did appear to be the case with two of the projects studied. Rather, the conclusion drawn was that those projects which created problems for the computer operations area were also somewhat unsatisfactory in the eyes of the users of the outputs. In other words, there was a tendency for shortcomings in the systems development work for these projects to be reflected in both inadequate planning for impact on computer operations and poor response to user information needs.

Tests of Hypotheses

Tables 16-19 provide a complete picture of the relationship between each hypothesis variable and each criterion variable.

TABLE 16

Success in Terms of Time

Actual Time/Estimated Time (Var. 48)

Rank		Var.	Tau	Z(s)	P(Z)
1	User Participation-User	46	-.181	1.061	.145
2	Measurable Project Objectives	12	-.219	1.142	.127
3	Project Team	14	-.130	.477	.316
7	Level of Information Systems Manager	9	-.292*	1.358	.087
8	Two or More Years Systems Experience	27	.203	1.193	.116
12	Documentation Standards	35	-.380*	1.753	.040
13	Project Control	42	-.153	.763	.223
14	Turnover	29	.082	.529	.300
16	Originator	11	-.037	.155	.439
17	Centralization	8	Not tested by this sample		
20	Two or More Years Organization Experience	34	.297*	1.740	.041
23	High Level Programming Language	43	-.315*	1.774	.039
31	Mean Years Formal Education	32	.630*	3.471	.0003
32	Combination Analyst/Programmer	23	.420*	1.562	.060
33	Systems Staff/Total Employees	61	.291*	1.659	.050
34	Hardware Investment/Sales	6	-.063	.330	.378

* - Significant at the .10 level or beyond - one-tailed.

TABLE 17

Success in Terms of Cost

Actual Cost/Estimated Cost (Var. 51)

Rank		Var.	Tau	Z(s)	P(Z)
1	User Participation-User	46	.154	.894	.185
2	Measurable Project Objectives	12	.100	.503	.309
3	Project Team	14	.210	.794	.214
7	Level of Information Systems Manager	9	-.240	1.107	.135
8	Two or More Years Systems Experience	27	-.104	.596	.275
12	Documentation Standards	35	-.200	.899	.185
13	Project Control	42	-.220	1.109	.134
14	Turnover	29	.030	.158	.437
16	Originator	11	.187	.930	.177
17	Centralization	8	Not tested by this sample		
20	Two or More Years Organization Experience	34	.055	.295	.384
23	High Level Programming Language	43	-.097	.519	.302
31	Mean Years Formal Education	32	.108	.567	.287
32	Combination Analyst/Programmer	23	-.010	.000	.500
33	Systems Staff/Total Employees	61	.263*	1.491	.069
34	Hardware Investment/Sales	6	-.023	.099	.461

* - Significant at the .10 level or beyond - one-tailed.

TABLE 18

Success in Terms of User Satisfaction

User Satisfaction-User (Var. 54)

Rank		Var.	Tau	Z(s)	P(Z)
1	User Participation-User	46	.440*	2.618	.005
2	Measurable Project Objectives	12	-.081	.403	.345
3	Project Team	14	.080	.278	.390
7	Level of Information Systems Manager	9	.105	.464	.322
8	Two or More Years Systems Experience	27	-.126	.729	.234
12	Documentation Standards	35	.090	.379	.352
13	Project Control	42	-.207	1.040	.149
14	Turnover	29	-.217*	1.480	.069
16	Originator	11	.420*	2.132	.017
17	Centralization	8	Not tested by this sample		
20	Two or More Years Organization Experience	34	.253*	1.477	.069
23	High Level Programming Language	43	.067	.346	.366
31	Mean Years Formal Education	32	.222	1.201	.115
32	Combination Analyst/Programmer	23	.420*	1.561	.060
33	Systems Staff/Total Employees	61	.229*	1.293	.098
34	Hardware Investment/Sales	6	.057	.296	.383

* - Significant at the .10 level or beyond - one-tailed.

TABLE 19

Success in Terms of Computer Operations

Computer Operations Problems (Var. 59)

Rank		Var.	Tau	Z(s)	P(Z)
1	User Participation-User	46	.180	.820	.206
2	Measurable Project Objectives	12	-.007	.000	.500
3	Project Team	14	-.050	.170	.433
7	Level of Information Systems Manager	9	B-.285*	1.340	.090
8	Two or More Years Systems Experience	27	-.255	1.176	.120
12	Documentation Standards	35	-.170	.811	.210
13	Project Control	42	-.060	.261	.397
14	Turnover	29	B .000	.000	.500
16	Originator	11	B-.147	.665	.254
17	Centralization	8	Not tested by this sample		
20	Two or More Years Organization Experience	34	.157	.707	.241
23	High Level Programming Language	43	B-.157	.695	.243
31	Mean Years Formal Education	32	.330*	1.542	.062
32	Combination Analyst/Programmer	23	.060	.204	.420
33	Systems Staff/Total Employees	61	.037	.143	.443
34	Hardware Investment/Sales	6	.232	1.063	.144

* - Significant at the .10 level or beyond - one-tailed.

Each of these tables shows the relationships between all sixteen of the variables representing hypotheses to be tested and one criterion variable. The sixteen hypothesis variables are shown in the same order as in the ranking in Chapter IV; the number to the left of each variable is the rank of that variable from the original list (Figure 2, Chapter IV).

Rather than merely repeat in narrative form what is contained in Tables 16-19, the comments here will be restricted to general observations about the findings shown in the tables, and discussions of those hypotheses which were significantly related to at least one criterion:

1. Each of the hypotheses was represented by one variable in the statistical analysis. Appendix E should be consulted for a description of what each variable is a measure of, and how it is scored. Of the sixteen hypotheses, all but one were tested by the data from the sample. Variable 8, representing the degree of centralization of the information systems function, was dropped from the analysis because of the lack of spread on the variable among the organizations in the sample. Eight organizations were scored at the highest level of centralization, and the remaining two were at the next to highest level, a result solely of small operations research groups which did some programming work.

2. Of the fifteen hypotheses which were tested, five were found not significantly related to any criterion. Those five were:

2	- Measurable project objectives -	Var. 12
3	- Project team	Var. 14
8	- Two or more years systems experience	Var. 27
13	- Project control	Var. 42
34	- Hardware investment/sales	Var. 6

The fact that those hypotheses which were not significantly related to any criterion were from the top, middle, and bottom of the ranked listing is of of some interest. At least for the sample involved in this study, those factors believed by the SMIS conference respondents to be most crucial to MIS project success did not prove to be so critical in the case of two of the three top ranked factors. Also of considerable interest was the lack of significant relationship between reported project control efforts and any criterion of success used in the study. This last finding will be explored further at a later point.

3. Of the ten hypothesized relationships which were found to be significant at the .10 level or beyond, four were cases where a hypothesis variable was significantly related to only one criterion

variable. The remaining six hypothesis variables were related to two or three criterion variables.

4. Looking at the tables from a criterion perspective, the time success criterion was significantly related to more hypothesis variables (7) than was any other criterion variable. User satisfaction was significantly related to six hypothesis variables, computer operations success to two, while cost success was significantly related to only one hypothesis variable.

<u>Hypotheses Significantly Related to Project Success</u>

Each of the hypothesis variables which was significantly related to at least one criterion of project success is dealt with briefly below:

1 - <u>User Participation-User</u> (Var. 46). As hypothesized, the higher the level of perceived user participation in design and development of a project, the greater the success of that project as viewed by the user. The statistical relationship between these two variables was very strong in the sample. However, perceived user participation in project development was not significantly related to any of the other three criteria of success.

7 - Level of Information Systems Manager (Var. 9). The higher the level of managers of the information systems departments in the organizations sampled, the less successful projects were in terms of time, and the more successful they were in terms of computer operations. Although there were no data from the study which explained these relationships very satisfactorily, it could be that the higher the level of the top computer executive in the organization, the less the felt pressure in the information systems function to meet time budgets. With respect to computer operations problems being less where the top computer executive was at a higher level in the organization, one possible explanation would be the apparent greater attention to computer operations requirements when the information systems function is accorded higher status in the organization. Put differently, where the organization has placed emphasis on using the computer effectively, as evidenced by locating the top computer executive close to top management, there may be more emphasis on assuring that computer operations requirements are considered in systems design.

12 - <u>Documentation Standards</u> (Var. 35). Where formal documentation standards were reported to have been applicable to projects in the study, the time success tended to be greater than where there were no such standards. It was impossible to determine whether the documentation standards themselves actually contributed to better performance in terms of time, or the existence of such standards merely reflected an atmosphere of greater control over information systems activities. In any case, this finding should be interpreted with caution due to the great extent of ties in the ranking of the dichotomous documentation standards variable.

14 - <u>Turnover</u> (Var. 29). As was pointed out in Chapter V, only three of the projects in the sample experienced any turnover of project personnel. Therefore, the negative relationship of turnover to user satisfaction must be interpreted very cautiously due to the great extent of ties in the turnover ranking. A close review of all the variables for those three projects with turnover led to the conclusion that the negative relationship with user satisfaction was a chance one, and should not be given much

credence. The reason for this conclusion was that in the case of only one project did low user satisfaction follow at all from project staff turnover. In that one case, the turnover was among key user representatives on the project team.

16 - Originator (Var. 11). The hypothesis that success is greater for projects originated by users, as opposed to those initiated by top management or the information systems staff, was confirmed where success was viewed in terms of user satisfaction. This would appear to stem in part from a greater feeling of participation among the users who originated projects, and, in part, from a greater clarity in what the users wanted when they initiated projects themselves. Where the users knew what they wanted, and participated in developing it, their satisfaction with the results tended to be greater.

20 - Two or More Years Organization Experience (Var. 34). The organization experience of the project staff was significantly related to two criteria: time and user satisfaction. In the case of time, the greater the organization experience of the project

staff, the poorer the time performance. This would seem to reflect a greater tendency for those who knew their organizations well to spend more time delving into the various ramifications and possibilities with projects once development was underway. This would likely draw out the time spent on the projects beyond what was originally anticipated. In the case of user satisfaction, the positive relationship to organization experience of the project staff indicated that the greater the proportion of those working on a project who understood the organization they were serving, the better the results in the eyes of the users. It is worth noting here that organization experience was not related at all to the measure of user participation. It might have been assumed that high organization experience would have reflected high proportions of user representatives on project teams, which, in turn, would have contributed to high levels of perceived user participation. Since user participation was highly related to user satisfaction, the assumption would then be that this last relationship was

really what was being picked up in a relationship between user satisfaction and organization experience of the project staff. This was not the case, however.

23 - <u>High Level Programming Language</u> (Var. 43). From the data in the sample, the hypothesis of greater project success with higher level programming languages was confirmed with respect to the time criterion. Where COBOL was the programming language used, the projects were completed in less time relative to estimates than where FORTRAN or assembly language was used. However, it should be noted that the types of projects were different where FORTRAN was used, and this in itself influenced the time performance. FORTRAN was used with modeling applications which were evolutionary in nature. Through trial and error processes, the models were developed to the point the users were satisfied with the results. This situation resulted in very extended development periods for these projects.

31 - <u>Mean Years Formal Education</u> (Var. 32). The mean education level of the project staff was

very strongly related to the time criterion of success. What this indicated was that the higher the education of those who worked on projects, the poorer the performance in terms of time. The only apparent explanation for this relationship was a tendency for those with more formal education to delve more deeply into possible enhancements and embellishments on the projects they worked on. Again, the influence of modeling applications should be considered in this connection. Those engaged in modeling applications generally had high levels of formal education. It will be recalled that the modeling projects, because of their evolutionary nature, were drawn out and usually way over the original estimates for time to completion.

Also of significance was the relationship of project staff education levels to computer operations success. One explanation for this relationship appeared to be the tendency for those with the greatest amounts of formal education to make provisions for the efficient computer implementation of their projects.

32 - <u>Combination Analyst/Programmer</u> (Var. 23). Where combination analyst/programmers were used to develop projects, the time performance was relatively poor, but user satisfaction was relatively high. While no explanation was readily apparent for the poor time performance where combination analyst/programmers were used, the high user satisfaction seemed to be attributable to the ability of the user to look to one person for any problem that arose. Where the user had to deal with an analyst in some cases, and with a programmer in others, there appeared to be user frustration and less satisfaction with the project as a whole.

33 - <u>Systems Staff/Total Employees</u> (Var. 61). Although they were all rather weak relationships, the relative size of the organization's systems staff was related to three separate criteria. Positive relationships to both the time and the cost criteria would seem to indicate that there was more slack in those organizations with large systems staffs. Where large staffs existed, the pressure to meet time and cost budgets or estimates did not seem to be as great.

As a consequence, time and cost performance were poor. However, user satisfaction was higher for those projects developed in organizations with larger systems staffs. Taken all together, the pattern would seem to be one of substantial organizational commitments to effective use of the computer as an aid to managerial decision-making, manifested through relatively large systems staffs which were oriented toward giving the users what they wanted at the expense of time and cost overruns.

Further Comments Concerning the Criteria of Success

Data were collected for several other variables besides the criteria and the hypotheses to be tested. To provide a more complete picture, all significant relationships between these other variables and the criterion variables are shown in Tables 20-23. These tables, and certain relevant non-quantitative findings, are discussed in this section.

Time Success (Var. 48). Table 20 contains those relationships between time success and other variables in the study which were significant at or beyond the .10 level. As might be expected, the projects with the greatest elapsed time had the poorest time success. Also, the higher the proportion of college degrees on project staffs, the poorer the time performance. This is merely another way of looking at the educational level, which was discussed earlier.

TABLE 20

Actual Time/Estimated Time (Var. 48)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
College Degree	30	.550	3.281	.0014
Elapsed Months	21	.515	3.081	.002
User Management Interest	39	-.367	1.864	.062
Time Success-PL	49	-.437	2.328	.020

From the data in the study, it appeared that high interest and involvement of top level user management contributed to better time performance. Where the top management levels of user organizations were actively engaged in promoting projects, those projects seemed to get completed faster relative to time estimates. This finding has interesting implications which tie in to some comments to be made later concerning the reward structures for systems people in organizations.

Another finding shown in Table 20 was the accuracy of project leader's perceptions concerning the success of their projects in terms of time. It should be borne in mind, however, that this relationship is based on asking the project leader only how successful he felt the project was in terms of time, with no consideration given to his views of other aspects of project success. This point, too, will be dealt with later

at greater length.

Cost Success (Var. 51). Table 21, consisting of only one entry, provides the same sort of confirmation of the project leaders' perceptions about project cost success as described just above for time success. Again, this point will be dealt with later in the context of global project success, and what that seemed to be comprised of in the eyes of project leaders.

TABLE 21

Actual Cost/Estimated Cost (Var. 51)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Cost Success-PL	52	-.644	3.444	.0006

In addition to the questions asked of project leaders which were tied to some kind of response scale, there were two-open-ended questions which permitted project leaders to state in their own words the reasons they felt their projects came out poorly on time and/or cost performance. These comments were reviewed by the researcher and classified according to eight response categories. The categories, and the number of projects falling into each, were as follows: (there were multiple responses for most projects)

1. Poor initial estimates; especially inadequate was the time allowed for implementation 10

2. Inexperience of the project staff with this particular type of application or language 7

3. Key people on the project were doing several things at once; competing demands for their time caused delays 4

4. The project was allowed to evolve over a long period of user learning and growth; no attempt was made to freeze requirements at one point and then consider the job done when those requirements were programmed 4

5. File handling problems; delays caused by waiting for data base development or accessibility 3

6. Poor computer test turn-around time. 2

7. Turnover of project staff. 2

8. Project was too large and complex to be managed. 2

From the above, it would appear that the greatest problem in meeting time and cost budgets, at least, in the eyes of project leaders, was poor estimates of time and cost in the first place. Actually, most of the other categories are related in some way to the first one. In estimating time to complete a project, the experience of the project staff should have been considered, as should the expected availability of computer test time, and so forth. This is not to say that every contingency could have been foreseen and provided for in making initial estimates, but it would seem that some factors

which did cause delays were not given adequate consideration at the time estimates were made.

One final point concerning project leaders' comments about time and cost performance is worth mention. In two cases, the project leader had no direct authority over programmers. This created communications problems which resulted in considerable confusion as to what was to be programmed, with attendant delays. Both of the projects were in the lower half of every criterion ranking.

User Satisfaction (Var. 54). A close scrutiny of the users' ratings of their satisfaction with the results of the projects in the study revealed several interesting points. It will be recalled that the measure of user satisfaction was a composite variable, made up of five separate items which were highly intercorrelated. However, one of the components of the user satisfaction variable, a measure of implementation problems, was also treated as a separate variable (53) for comparative purposes. As Table 22 shows, the users viewed the ease or difficulty of implementing a completed project as a very important aspect of the perception of project success.[1]

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[1]While there is bias in the value of tau shown in Table 22, due to the inclusion of the implementation problems variable in the user satisfaction variable, it is apparent that implementation was a large factor in the minds of users in evaluating the success of projects.

TABLE 22

User Satisfaction-User (Var. 54)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Implementation Problems-User	53	.720	4.192	.0004
User Satisfaction-PL	57	.656	3.584	.0004
Project Success-PL	56	.607	3.124	.002
Computer Operations Cost	60	.347	1.796	.074
Satisfaction of Objectives-PL	55	.320	1.687	.092
Man Months	22	-.280	1.668	.096

It is also noteworthy that the variable representing the project leader's perception of implementation problems (58) was not significantly related to user satisfaction. This last observation will be pursued further at a later point, but it is apparent that users viewed implementation problems differently than project leaders viewed them. This conclusion is supported by the very strong relationships between user satisfaction and three variables representing the project leader's evaluation of project success. These three variables, shown in Table 22, were the project leader's perception of how satisfied the users were with the project results (57), how successful the project leader felt the project was overall (56), and how well

the project leader thought the original objectives for the project had been satisfied (55). In other words, users and project leaders agreed very well on the relative success of a project, but implementation problems were a factor in the users' evaluations while they were not a factor in the project leader's evaluation of project success.

Another very interesting aspect of user satisfaction came to light in looking at the relationships among the various criteria. It was felt that users might have been dissatisfied with projects which took too long to complete; that they disliked waiting for something they felt they needed. To get at this question, the individual projects that had the worst performance on time were checked for user satisfaction scores. It was already known that these two criteria were not significantly related for the whole study, but it was felt that looking at the extremes might reveal something that was hidden in the sample statistics. The surprising result of this investigation was that the project ranked last on time success was ranked third on user satisfaction, and the project ranked next to last on time success was ranked second on user satisfaction. In other words, two of the top three projects in terms of user satisfaction were the two bottom projects on time success. Upon closer review, what appeared to be underlying this finding was the evolutionary nature of the two projects in question. Both projects involved rather

complex models which were developed over a fairly long period of trial and error. Rather than taking a set of user stated desires or needs, and developing some programs to satisfy them, the systems staffs concerned worked very closely with the users in evolving those products which best fit the users' needs. There seemed to have been tacit recognition that the users would learn as they went, that they would become more sophisticated as they worked with outputs at successive stages of development, and would, therefore, not be satisfied with a one-shot development effort. Although the users were highly satisfied with what they ultimately received from the projects, this evolutionary approach took much longer than had originally been anticipated.

Based on the above findings, an effort was made to discover other evidence in the data which supported what has been called the evolutionary approach to project development. It was hypothesized that projects which had not been developed with such an evolutionary strategy would reflect the following characteristics:

> Users who were originally satisfied with project results at the time the projects were completed might now be less satisfied with what they were receiving. This shift in satisfaction over time would have resulted from a user learning process which was not matched by any enhancements in the

information system outputs they were receiving. In other words, as the users became more sophisticated through working with the products of the projects in question, their information needs would shift. If the information system products did not shift with this increasing sophistication, the users would now be less satisfied with the projects than when they were first implemented.

To test the above hypothesis, two separate components of the user satisfaction variable were analyzed. These components represented a measure of how well the user felt the original project objectives had been met, and a measure of how satisfied the user now was with the products of the project. It was already known that these two components of overall user satisfaction were highly correlated. However, it was not known if these two factors were scored at about the same level on a project by project basis. To get at this latter question, the mean value and the standard deviation were computed for each factor. These statistics were then used in testing the difference between the two means to determine its significance. The mean value for the factor measuring how well original objectives were reportedly met was 39.2 with a standard deviation of 9.8. The mean and standard deviation for the reported current satisfaction factor were 33.5 and 10.3, respectively. The difference between these two means was 5.7, which, when tested by the t

statistic with 38 degrees of freedom, was significant beyond the .10 level for a two-tailed test.

Although the t test described above was retrospective, and, therefore, not generalizable beyond the sample, it was interpreted as an indication that the users in the study did shift their perceived information requirements fairly quickly after MIS project implementation. While users may have scored a project very high on how well it served their information needs when first implemented, they tended to score present satisfaction at a lower level. This interpretation would seem to be a good argument for the evolutionary approach to MIS projects since such projects have been defined as management-decision oriented.

Finally, with respect to user satisfaction, Appendix G contains comments by users relative to what they believed should have been done to improve the projects in the study, and what they view present shortcomings to be. These comments are not direct quotes; rather, they represent the notes taken by the researcher as the users responded to an open-ended question in the questionnaire (Appendix B, page 222).

Computer Operations Problems (Var. 59). As reflected in Table 23, the measure of computer operations success used in the study was related to a secondary measure of such success, namely, the operations cost of a project. This relationship indicates that projects which were implemented most smoothly by computer operations were also the most successful in terms

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of computer operating costs. This relationship is not surprising, and would appear to be the underlying explanation of the relationship between user satisfaction and operations cost success shown in Table 22. It will be recalled that the relationship of user satisfaction to computer operations success was discussed earlier.

TABLE 23

Computer Operations Problems (Var. 59)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Computer Operations Cost	60	.420	2.078	.038

Further Comments Concerning the Hypothesis Variables

Tables 24 through 37 contain relationships of the hypothesis variables to other non-criterion variables for which data were collected in the study. Each relationship tabled will not be dealt with in detail. Rather, patterns that were detected, and findings of particular interest, will be dealt with. The discussions which follow are oriented around the hypothesis variables, and are presented in the same sequence in which these variables appeared in the earlier chapter dealing with the testing of the hypotheses.

User Participation-User (Var. 46). User participation in project development, as perceived by user personnel, was

related to more separate variables than any other variable in the study, as shown in Table 24. However, several of these relationships tended to cluster together, revealing what appeared to be more basic underlying relationships.

TABLE 24

User Participation-User (Var. 46)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
User Satisfaction-PL	57	.644	3.530	.0004
Project Success-PL	56	.553	2.887	.004
Satisfaction of Objectives-PL	55	.513	2.767	.006
Time Success-PL	49	.506	2.737	.006
Assets	1	.417	1.904	.058
Specificity of User Requirements-PL	38	.400	2.160	.030
Measurable Project Objectives	12	.394	2.112	.036
Complexity	13	.369	2.009	.046
User Participation-PL	41	.367	2.174	.030
Specificity of User Requirements-User	45	.356	2.111	.034
Hardware Investment/Sales	6	.309	1.772	.076
Implementation Problems-User	53	.291	1.701	.090
Two or More Years Systems Experience	27	B-.353	1.984	.048

User participation was significantly related to four separate measures of how successful the project leader perceived the project to be (Variables 49, 55, 56, and 57). The underlying relationships here would appear to be the relationship of user participation to user satisfaction, and the relationship of user satisfaction to the project leader's perceptions of success. One interesting exception was the relationship of user participation to the project leader's perception of time success. It appeared that where perceived user participation was high, project leaders tended to discount the actual time performance in evaluating time success. This, in turn, implies that project leaders were more oriented to how the users viewed the projects than to the actual time spent compared to time estimated. This observation will be dealt with in more detail further on.

Those users in organizations which were large in terms of assets, and which had high computer hardware to sales ratios, felt that they participated more in project development efforts. This probably reflected a stage of development in computer usage which the larger, more heavily computer oriented organizations had reached.

With respect to the reported specificity of project requirements, and the reported clarity of project objectives, user participation was perceived to be higher when the measures of these variables were higher. It was difficult to determine

precisely what was behind these relationships, but it seems that users felt they participated to a greater extent where projects were well defined and objectives were clearly stated from the beginning. The specificity and clarity of objectives would indicate that users knew what they wanted and were in a position to actively work with the systems staffs in getting it. Where objectives were vague, and the users weren't really certain what they were after, the information systems staffs picked up the ball and did more or less as they saw fit. This is not to impugn the information systems staffs. Rather, given somewhat vague requirements, they had to fill in the gaps themselves to get something running, relegating the users to question-answerers when the systems people got stuck. The important implication in these conclusions would seem to be the necessity for clear objectives and specific information requirements from users if the users want to be heavily involved in the development effort, thus providing greater assurance that the project results will satisfy their information needs.

Perceived user participation was also related to having fewer implementation problems. This logically would follow from closer user involvement during project development, thereby providing the users with a more precise understanding of what was to be implemented and possible attendant problems.

Finally, one relationship shown in Table 24 which may appear somewhat odd was the one between perceived user

participation and the systems experience of the project staff. Being a negative relationship, one might conclude that staff personnel with greater systems experience did not permit much user participation. What actually seems to have been the case, however, was that user members of project teams, having little, if any, systems experience, pulled the systems experience measure down. Since having user personnel on project teams generally contributed to higher perceptions of user involvement, the negative relationship between participation and systems experience resulted.

Measurable Project Objectives (Var. 12). There were two main clusters of variables related to the reported clarity of project objectives. The first cluster, consisting of Variables 1, 2, 3, and 6 in Table 25, represent organization and computer installation size. The larger organizations, and those most heavily committed to computerized information processing, tended to have the most specific and measurable project objectives. This, again, would seem to indicate a more advanced stage of computer usage.

The second cluster of variables (14, 27, 39, 41, and 46) seems to represent the effects of clear project objectives on other aspects of project development. Where project objectives were reported to have been clearly stated from the beginning of a project, the users appeared to be more involved in all subsequent project efforts, a point made earlier. Project teams

were more common, top level user management took a more active interest in what was happening, and user participation, as perceived by both the project leaders and users, was higher. All of these factors combined to present a picture of users knowing what they wanted and actively participating with the systems staff in getting it. In addition, where project objectives were reported to have been clearly stated in the beginning, there were fewer course changes during project development, as indicated by the negative relationship between objectives and the measure of project change requests honored by the project staff (Var. 40).

TABLE 25

Measurable Project Objectives (Var. 12)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Project Team	14	.580	2.320	.020
Assets (14 projects)	1	.574	2.507	.012
Employees	3	.437	2.321	.020
Number on Project	17	.400	2.138	.032
User Participation-User	46	.394	2.112	.036
Sales (18 projects)	2	.386	1.921	.054
User Management Interest	39	.347	1.806	.072
User Participation-PL	41	.344	1.830	.068
Hardware Investment/Sales	6	.312	1.660	.096
Two or More Years Systems Experience	27	-.400	2.146	.032
Changed as Requested	40	-.405	1.922	.054

An interesting exception to the above general conclusions was the case where project objectives were scored high, but the specific user requirements were scored low. There were three projects in this category. For these three projects, the original objectives were reported to have been quantified and clear. However, while the users apparently knew what they wanted to achieve, they didn't appear able to define the information content or format they needed to achieve it. In essence, project development seems to have begun before the users had analyzed their own information requirements well enough to define them clearly to the systems staff. The result in all three cases was considerable frustration among all concerned, and very poor time performance on the projects involved. The point of all this is that specific user requirements did not automatically follow from well specified objectives, and where they did not, considerable difficulties were encountered in project development. The fact that users were able to state clearly <u>what</u> they wanted to achieve did not mean that they understood their own information-decision environments well enough to plot a course to get there.

<u>Project Team</u> (Var. 14). It was expected that the use of a project team, composed of user representatives and information systems staff, would enhance the level of user participation in project development. This expectation was confirmed when user participation was seen through the eyes of the project leader.

Where there were teams, consisting in part of user personnel, project leaders felt that objectives were clear, user requirements were more specifically stated, and user participation was quite high (see Table 26).

TABLE 26

Project Team (Var. 14)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Specificity of User Requirements	38	.750	3.032	.0027
User Participation-PL	41	.660	2.603	.009
Measurable Project Objectives	12	.580	2.320	.020
Number on Project	17	.500	1.964	.050
Two or More Years Systems Experience	27	-.760	3.018	.004

However, the measure of user participation representing the users' perceptions was not significantly related to the existence of a project team. This surprising finding for the whole sample led to a detailed review of each project in an effort to explain the divergence of the users' and the project leader's views of ostensibly the same factor, user participation. This detailed review revealed the following:

1. The three highest ranked projects on user participation (users' view) were all developed by project teams.

2. The two lowest ranked projects on user participation (users' view) were not developed by project teams.
3. Four projects where teams were used, but which had low ranks on user participation (users' view), seemed to reflect considerable disagreement among individual user respondents on how much they, as users, participated in project development.

To explore item 3 above further, eighteen of the questionnaires were analyzed in terms of individual user responses to the four questions that were aggregated in arriving at the user participation scores for these projects. Only eighteen projects were analyzed, since for two projects there was only one user, and no disagreement on the separate questions was possible. For each of the eighteen projects analyzed, an "index of disagreement" was computed as follows:

> For each of the four questions comprising the composite variable, user participation, the difference between two separate user responses was determined by merely subtracting the low response from the high response on the fifty point scale. These four differences were then summed together to get an index of disagreement for the project. For example,

> if one user responded to the question "What was the degree of your organization's active participation throughout the evolution of this project?" with a scale value of forty, and the other user responded with a scale value of twenty, the difference for that one question was twenty. That difference was then added to the remaining three differences computed in the same manner to arrive at the index value for the project.

The mean value of the index of disagreement for all eighteen projects was 45.6. When the index of disagreement value for each of the four projects mentioned in item 3 above was compared to this mean index value, it was found that these four projects had the highest index of disagreement scores in the sample, with two at 70, one at 100, and one at 120. Further, all four of these projects had one thing in common: each was a case where one of the user personnel interviewed had actually worked on the project team and the other user had not. As would be expected, the individuals who had actually been on project teams scored user participation consistently higher than did the users who had not been on the project teams.

What the above findings would seem to indicate is that users disagreed among themselves concerning how much they

participated in a project. While the individuals who were actually on the team felt that participation was high, other users often felt they had very little to do with the project. Where the objective of a project was to provide management information to several people in a user area, in fact, only those who actually were on the project team ended up getting what they wanted. Thus, while having a project team did seem to facilitate users feeling they participated to a larger degree, a team did not assure such feelings of participation. This situation was particularly obvious where the user representatives on a team were staff personnel from the user area, but the actual recipients of the results of the project were other individuals who had not been very much involved in project development.

With respect to the perceptions of project leaders concerning user participation, no distinctions were apparently made among the kinds of users who were on project teams. The mere presence of user representatives led to perceptions of high user participation, thus the high relationship between Variables 14 and 41 in Table 26.

Another finding of interest relative to the use of project teams, was that user satisfaction with results was lower where the user members of project teams were not the ones responsible for implementing the completed projects, nor for maintaining on-going liaison with the information

systems staffs. There were two projects which fell in this category. Whereas the mean value of user satisfaction (Var. 54) for all projects in the sample was 175, the mean value of user satisfaction for the two projects cited was 122.5. Both of these projects were in the bottom half of the user satisfaction ranking, with ranks of 12 and 15.

Finally, the fact that user representatives were full-time or part-time on project teams seems to have made no difference on any criterion. Having part-time or full-time user members on a project team appeared to depend more on the nature of the project and the structure of the organization than anything else.

As would be expected, Table 26 shows that there tended to be more people involved in projects where teams were used. Also, the level of systems experience was lower where teams were used, since users, who had little or no systems experience, pulled the measure of systems experience down.

<u>Level of Information Systems Manager</u> (Var. 9). For the seven organizations in the sample which provided asset data, the larger organizations, in terms of assets, tended to place the top information systems executive closer to the top operating executive of the organization. This is reflected in Table 27 as a negative relationship, since a lower value for Variable 9 meant fewer hierarchical levels between the information systems executive and the top operating executive.

TABLE 27

Level of Information Systems Manager (Var. 9)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	S*	P(s)
Assets (N=7)	1	-.796	-13.0	.07

* Since asset data were available for only 7 organizations, the normal deviate was replaced by the actual computed value of S. The probability level was determined from Sillitto (1947).

Two or More Years Systems Experience (Var. 27). All of the relationships shown in Table 28 would seem to reflect, essentially, the degree of user involvement in the projects in the study. There are no relationships there which are not consistent with the discussions already presented for other variables. Clear objectives, specific user requirements, user participation, the number of people on the project, and the use of a project team have all been shown to be related to each other. Since what was posited as underlying all of these relationships was user involvement, it is not surprising that all of the variables shown in Table 28 were negatively related to the systems experience measure, inasmuch as that measure was lower the more users were directly involved in project development.

TABLE 28

Two or More Years Systems Experience* (Var. 27)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Project Team	14	-.760	3.018	.003
Specificity of User Requirements-PL	38	-.450	2.453	.014
Measurable Project Objectives	12	-.400	2.146	.032
Number on Project	17	-.394	2.311	.022
User Participation-PL	41	-.361	2.141	.032
User Participation-User	46	B-.353	1.984	.048
User Satisfaction-PL	57	-.319	1.730	.084

*Since all values for tau are negative in this table, the entries are from most negative (strongest relationship) to least negative (weakest relationship).

Documentation Standards (Var. 35). Although the reported existence of formal documentation standards is shown to be related to three variables in Table 29, great caution must be exercised in making any generalizations about these relationships. Only four projects in the study had no documentation standards, and two of these projects were in one organization. This organization was the smallest in the sample in terms of sales, and next to the smallest in number of employees. Further, all of the project staff members for both

of these projects held college degrees. A third project for which no formal documentation standards applied was in the smallest organization in the sample in terms of employees, and this organization was next to the smallest in sales. This third project, a sophisticated modeling application, was also developed by a team composed entirely of college graduates. These factors, together with the nature of the tau statistic computation, explain the relationships found. Therefore, generalizing in this case would be very hazardous.

TABLE 29

Documentation Standards (Var. 35)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Sales (18 projects)	2	.543	2.559	.010
Employees	3	.520	2.149	.032
College Degree	30	-.490	2.304	.022

Project Control (Var. 42). The primary conclusion one draws when looking at the relationships between the project control measure and other variables in the study is that reported project control efforts were, essentially, ineffective, perhaps even dysfunctional. It has already been shown in Tables 16-19 that reported project control efforts were not related to any criterion of success. This would seem to indicate that

project status information, which was ostensibly collected for control purposes, was not, in fact, used to exercise control, at least over the project itself. It is worth noting that of the twenty projects in the study, in only one case did project status reporting result in additional resources being committed to the project. That one project was completed on time. In other projects, however, it appeared that project status information was collected as "nice to know", or, at best, was used to keep others outside the information systems function posted on when they would be affected by conversion or implementation activities. This is not to say that such overall organizational awareness is not desirable nor necessary. But awareness and positive steps to influence project development rate are not synonymous.

Analysis of Table 30 reveals some further interesting aspects of project control. Although reported project control was not related to time success, it was quite strongly related to the project leader's perception of time success. What this relationship seems to reflect was the tendency of the project leader to feel he had done his best where he was constantly maintaining close tabs on project status. He didn't feel the project had really been so bad in terms of time success, and tended to blame overruns on poor estimates, although in only one case did a project leader feel the original time estimate for the project had been unrealistic! In fact, two projects, which exceeded time estimates by 600% and 900%, were rated

average in terms of time success, and three projects, which exceeded time estimates by 135%, 146% and 180%, were all rated above average on time success.

TABLE 30

Project Control (Var. 42)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Time Success-PL	49	.540	2.861	.004
Originator	11	-.322	1.722	.084
Quality of Documentation	36	B-.336	1.650	.100
Changed as Requested	40	-.345	1.683	.092

It appeared that project leaders felt an implicit pressure from tight project reporting requirements, but they felt helpless in doing anything about improving poor performance beyond cutting corners in such areas as documentation and preparation for implementation. The negative relationship between reported project control efforts and the perceived quality of documentation would seem to lend support to this notion, as would the negative relationship between reported project control and perceived implementation problems. This latter relationship is not tabled, as it was not significant at the .10 level, but it was fairly strong, with a tau of -.307 and a normal deviate of 1.638.

Another indication of the pressure felt by the project leader from project control schemes was the reported reluctance to make changes as development progressed. This was not necessarily a bad thing, but the pressure to get done as soon as possible seems to have prevented changes needed to provide users with more acceptable outputs in some cases. Although the reluctance to make desired changes did not seem to contribute to being on time with projects, it probably did prevent several of the projects from being more over estimate than they already were.

Finally, as shown in Table 30, those projects initiated by the information systems staffs appeared to be subject to more stringent control requirements than those initiated by users. It would seem that the planning process for project development was more explicit when a project came from the information systems staff, resulting in more specific provisions for control of the project during its development. This observation opens up some very interesting possibilities with respect to kinds of information systems projects. These possibilities will be dealt with in Chapter VIII.

<u>Turnover</u> (Var. 29). It was pointed out earlier that the turnover of project personnel could not be fairly evaluated because only three projects in the study experienced any turnover at all. The same caution must be observed in considering the relationship of turnover to implementation problems, as

viewed by the project leader, shown in Table 31. While the turnover that did occur on projects in the sample appeared to create real difficulties for the project leaders of those projects, it would be risky to generalize beyond those projects. The discussion of just what implementation problems seemed to consist of in the eyes of project leaders will be dealt with in the next chapter.

TABLE 31

Turnover (Var. 29)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Implementation Problems-PL	58	-.322	2.327	.020

Originator (Var. 11). The relationship of reported project control efforts to origin of a project has already been discussed. The relationship of project origin to implementation problems, as viewed by the user, shown in Table 32, indicates that users felt they had less difficulty implementing projects they initiated than those initiated by higher level management or information systems staffs. This finding is not at all surprising, and fits the patterns of relationships already discussed.

One finding that was surprising, however, was the absence of a significant relationship between origin of a

project and the users' perception of participation in project development. Although these two variables were related, with a tau of .29 and a normal deviate of 1.493, this relationship failed to reach significance at the .10 level.

TABLE 32

Originator (Var. 11)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Implementation Problems-User	53	.330	1.709	.088
Project Control	42	-.322	1.722	.084

A closer investigation of the sample data revealed what would appear to explain this situation. Two of the thirteen projects initiated by users had very low values for perceived user participation, 120 in both cases. This value was well below the overall mean for user participation, 152.6, and was far below the mean user participation value of 164 for those thirteen projects which were originated by users. The two projects in question, although originated by users, were developed, for the most part, without further substantive user participation. In one case, this appeared to be the result of the users not wanting to be bothered; and in the other case, the project leader simply did not work with the users, choosing to proceed on his own. It is worth noting that these two projects

were both very low in the ranking of user satisfaction, with one project ranked 17, and the other project ranked 18.

Based on the above findings, it appears that the fact a user originated a project did not guarantee his participation in its development. However, the results were not very satisfying to the user where participation did not follow from project initiation.

Centralization of MIS Activities (Var. 8). This variable was not adequately tested in the present study.

Two or More Years Organization Experience (Var. 34). There were few findings with respect to organization experience of the project staff which were of any significance. As might be expected, Table 33 shows that larger organizations, in terms of numbers of employees, had project staffs with less organization experience. This might be interpreted as an indication that more fluid personnel situations existed in larger organizations. Table 33 also shows that the education level of the project staff was related to organization experience. This finding would seem to run counter to the popular notion that people involved in systems work, and who are highly educated, have high job turnover rates. At least for this sample, those who were more highly educated tended to have been in their current organizations for at least two years. Caution must be exercised in making too much of the above finding concerning turnover and education, however. The

measures used were not direct individual measures of job longevity and education level. Rather, they were mean values and proportions, which were felt to be the best types of measures for the primary tasks in this study, but which were not the best measures for an analysis of turnover as it relates to education.

TABLE 33

Two or More Years Organization Experience (Var. 34)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
College Degree	30	B.375	2.132	.034
Mean Years Formal Education	32	.372	2.046	.040
Employees	3	-.411	2.401	.016

<u>High Level Programming Language</u> (Var. 43). The relationship between the use of a higher level programming language and the quality of project documentation, shown in Table 34, reflects primarily the views of project leaders that the use of COBOL resulted in good program documentation. Since the perceived quality of program documentation appeared to be a key element in evaluating overall project documentation, this finding is not surprising.

TABLE 34

High Level Programming Language (Var. 43)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Quality of Documentation	36	.300	1.780	.076

Mean Years Formal Education (Var. 32). The relationship found between project personnel education levels and organization experience has been dealt with to some extent in the discussion of the organization experience variable. As shown in Table 35, there were four other variables significantly related to project staff education besides organization experience. Looking at all five of these variables together, one finds a pattern that seems to explain their relationships to education levels of project staffs. The smaller organizations in the sample, in terms of numbers of employees, tended to have smaller project staffs whose members had high education levels, and who had been employed in their respective organizations for over two years. Further, smaller project staffs tended to have combination analyst/programmers. Finally, users generally perceived implementation problems to be the least where combination analyst/programmers developed projects (see Table 36). The above pattern was particularly pronounced where applications dealing with mathematical models were involved. This does not mean that smaller organizations

had the most successful projects or the projects with the least implementation problems. Rather, the interrelations of the several variables discussed provide a possible explanation for findings relative to the education level of project personnel.

TABLE 35

Mean Years Formal Education (Var. 32)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Combination Analyst/Programmer	23	.440	1.668	.096
Two or More Years Organization Experience	34	.372	2.046	.040
Implementation Problems-User	53	.336	1.884	.060
Number on Project	17	-.330	1.821	.068
Employees	3	-.378	2.073	.038

TABLE 36

Combination Analyst/Programmer (Var. 23)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
College Degree	30	.590	2.238	.026
Implementation Problems-User	53	.530	2.029	.042
Mean Years Formal Education	32	.440	1.668	.096
Man Months	22	-.500	1.868	.062
Number on Project	17	-.610	2.306	.022

Combination Analyst/Programmer (Var. 23). The finding in the study that project staffs comprised of combination analyst/programmers had higher levels of education has already been mentioned in the preceding discussion of the primary measure of education level. Table 36 also shows that there were higher proportions of college degrees on project staffs composed of combination analyst/programmers. This is merely one more way of looking at the same basic relationship.

The tendency for users to feel implementation problems were less with combination analyst/programmers has also been cited on several occasions. As was pointed out before, users seemed to feel frustrated and somewhat dissatisfied with implementation efforts where they had to deal with different people from the information systems staff, depending on the nature of the problems that came up. The ability to deal with one person who understood all aspects of the project, and who could respond to problems with action, was often mentioned by users as a very strong factor in their satisfaction with project results. It appears that combination analyst/programmers were better able to meet users' desires in this respect than were separate analysts or programmers.

Finally, combination analyst/programmers generally meant fewer people on a project, and the projects they worked on took fewer man months. This latter relationship is open to interpretation. It could be that since there were fewer

people working on projects where combination analyst/programmers were used, the man months being less just reflected that underlying relationship. On the other hand, it could be that there was less lost time and motion where combination analyst/programmers were used, thus requiring fewer man months to complete a project. While this latter argument is appealing from a logical standpoint, it is hard to support in view of the fact that, as shown earlier in the discussion of criteria-hypotheses relationships, project staffs composed of combination analyst/programmers performed rather poorly on the time success criterion. Another possible explanation might be that combination analyst/programmers were used on smaller, less complex projects. This position is also difficult to defend, however, since there was little relationship between the measure of complexity (Var. 13) and the use of combination analyst/programmers. Perhaps the question could have been resolved had there been a comparable, objective measure of project complexity which was applied equally to all projects by the researcher. In the absence of such a measure, no satisfactory explanation could be found by the researcher for the relationship between using combination analyst/programmers and man months spent on a project. The whole question of combination versus separate analyst/programmers would seem to be a very fruitful one for further research.

Systems Staff/Total Employees (Var. 61). The measure of relative size of sample organizations' systems staffs was not significantly related to any other independent variable with which it was cross-tabulated.

Hardware Investment/Sales (Var. 6). Organizations in the sample with the highest asset valuations also tended to have the highest ratios of computing hardware investment to sales for the past fiscal year. This relationship was computed for only the seven organizations which provided asset data, however (see Table 37).

TABLE 37

Hardware Investment/Sales (Var. 6)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Assets (N=7)	1	.784	S=16.0*	.02
Measurable Project Objectives	12	.312	1.660	.096
User Participation-User	46	.309	1.772	.076

* Since asset data were available for only 7 organizations, the normal deviate was replaced by the actual computed value of S. The probability level was determined from Kendall (1962).

The hardware investment/sales ratio was also related to the reported clarity of project objectives, and to user perceptions of participation in project development. It has

already been shown that perceived user participation was related to reported clarity of project objectives (Table 24). As was pointed out in the discussion of relationships shown in Table 24, a high hardware/sales ratio was construed to represent a strong commitment by an organization to computerized processing of information for decision making. In such an environment, it appears that clear objectives were required before a project was initiated, and users were more involved in the planning for their own information systems.

CHAPTER VII

OTHER RELATIONSHIPS OF INTEREST

Although the author's primary intent in this thesis has been to report the results of conducting tests of the hypotheses posited for the study, the nature of the data collected has made it possible to investigate and report certain other relationships of relevance and interest. Some of these "other" relationships have already been discussed in the last two sections of Chapter VI. This chapter focuses mainly on those findings which provide insight into the ways project leaders viewed their respective projects.

Project Leaders' Views on Project Success

Tables 38-41 provide a picture of the way project leaders viewed project success in terms of time, cost, user satisfaction, and for the project overall. No attempt has been made to discuss every relationship shown in all four tables. Rather, what appeared to be meaningful patterns of relationships have been dealt with.

First, although project leaders' evaluations of time and cost success were related to the actual measures of time success and cost success respectively, the most prominent factor underlying the overall evaluations of success appeared to be how satisfied the project leaders perceived the users were with the project results. To support this contention,

consider the results in Tables 40 and 41. When asked to rate their projects on how successful they were overall, the project leaders' responses were related to a cluster of other variables which represented, essentially, user satisfaction. The only exception was the relationship between overall project success and time success.

TABLE 38

Time Success-PL (Var. 49)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Project Control	42	.540	2.861	.004
User Participation-User	46	.506	2.737	.006
Project Success-PL	56	.487	2.578	.010
Cost Success-PL	52	B.447	2.335	.020
Specificity of User Requirements-User	45	.394	2.114	.034
User Satisfaction-PL	57	B.387	2.006	.044
Elapsed Months	21	-.369	1.963	.050
Actual Time/Estimated Time	48	-.437	2.328	.020

TABLE 39

Cost Success-PL (Var. 52)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Time Success-PL	49	B.447	2.335	.020
Number on Project	17	-.319	1.707	.088
Actual Cost/Estimated Cost	51	-.644	3.444	.0006

TABLE 40

Project Success-PL (Var. 56)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
User Satisfaction-PL	57	.713	3.837	.0002
User Satisfaction-User	54	.607	3.124	.002
Implementation Problems-User	53	.553	2.920	.004
User Participation-User	46	.553	2.887	.004
Time Success-PL	49	.487	2.578	.010
Satisfaction of Objectives-PL	55	B.407	1.979	.048
Specificity of User Requirements-PL	38	.367	1.937	.052

TABLE 41

User Satisfaction-PL (Var. 47)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Project Success-PL	56	.713	3.837	.0002
User Satisfaction-User	54	.656	3.548	.0004
User Participation-User	46	.644	3.530	.0004
Implementation Problems-User	53	.519	2.871	.004
Satisfaction of Objectives-PL	55	.447	2.469	.014
Specificity of User Requirements-PL	38	B.409	2.116	.036
User Participation-PL	41	.394	2.135	.032
Time Success-PL	49	B.387	2.006	.044
Two or More Years Systems Experience	27	-.319	1.730	.084
Man Months	22	-.350	1.880	.060

While it appears that project leaders did give some consideration to time success, as they had evaluated it, in arriving at an overall rating of project success, that relationship, too, may reflect a "user satisfaction" bias. This last statement follows from the findings in Table 38. Time success, as viewed by the project leader, was related to reported project control, which has already been discussed; to the actual time success measure; and to the project leader's rating of cost success. However, it was also related to user satisfaction, as viewed by the project leader, perceived user participation, and the reported specificity of user requirements. These last mentioned relationships could reflect the tendency of project leaders to view time success in the context of how satisfied they felt users were with project results. This possibility is supported by the fact that the two lowest ranked projects (19 and 20) on the user satisfaction criterion were rated at the lowest level (very poor) on time success (Var. 49) by the project leaders. However, these two projects were ranked 13 and 14 on the actual measure of time success (Var. 48).

On the other hand, it may be that project leaders did rate overall project success with consideration given to their perceptions of both time success and user satisfaction. If this was the case, and the two projects cited in the previous paragraph were merely chance occurrences, the user satisfaction

relationship to perceived time success could be explained by the common relationship of both of those variables to overall project success (Var. 56).

With respect to the strong relationship between the project leader's perceptions of time success and cost success, it would appear that a project leader response set was partially responsible for this relationship. Although, as Table 15 shows, the actual measures of time success and cost success were related, that relationship was not significant at the .10 level. This led to the conclusion that project leaders tended to rate cost success and time success at about the same level, regardless of how similar the actual time success and cost success values were.

Perhaps the most important point to be made concerning the relationships shown in Tables 40 and 41 is how accurately the project leaders perceived user satisfaction with their projects. It was evident that in nearly all cases, project leaders were very well attuned to how the users viewed project results. It was also apparent, as has been discussed above, that those user attitudes were key determinants in how successful project leaders viewed their projects to be.

Different Views of Implementation Problems

One interesting aspect of project leaders' perceptions concerning user satisfaction was their awareness of implementation problems, as viewed by the users. As Tables 40 and 41

show, the users' evaluation of implementation problems was very strongly related to how well satisfied the project leader perceived the users to be, and, in turn, to how successful the project leader felt the overall project was. It has already been shown (Table 22) that users considered ease or difficulty of project implementation to be a very significant component of overall satisfaction with a project.

However, as Tables 42 and 43 show, project leaders viewed implementation problems very differently than users did. Not only were the two views of implementation problems different, project leaders did not even consider implementation problems to be related to any criterion of success.

Most of the relationships in Table 42 have been covered in earlier discussions of the several variables shown, so there is no need to repeat what has been said about them. However, taking all of the variables together, and considering the pattern, provides insight into what decreased implementation problems from the users' perspective.

Implementation to users appears to have meant getting the project and its outputs incorporated into their ongoing operations as smoothly and effectively as possible. The objective of the user was to get an information system product which aided in decision making, but which also caused the least turbulence in the organization. Achieving this objective appeared to be tied to how prepared the user was for what he got.

TABLE 42

Implementation Problems-User (Var. 53)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
User Satisfaction-User	54	.720	4.192	.0004
Project Success-PL	56	.553	2.920	.004
Combination Analyst/Programmer	23	.530	2.029	.042
User Satisfaction-PL	57	.519	2.871	.004
Specificity of User Requirements-PL	38	.419	2.290	.021
Mean Years Formal Education	32	.336	1.884	.060
Quality of Documentation	36	.333	1.739	.082
Originator	11	.330	1.709	.088
User Participation-User	46	.291	1.701	.090
Man Months	22	-.383	2.217	.026

TABLE 43

Implementation Problems-PL (Var. 58)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Quality of Documentation	36	.533	2.869	.004
Turnover	29	-.322	2.327	.020
Complexity	13	B-.352	1.793	.074

When he had originated a project, participated heavily in its development, and had good project documentation to work with, the user knew what was coming. Further, where he was able to deal with one individual who knew the whole picture when problems did arise, the user felt he was able to get those problems rectified quickly.

Contrast this to how the project leader viewed implementation problems. Although, as was mentioned earlier, the project leader was aware of the users' view of implementation problems, he did not consider the same factors to be the components of implementation problems, with the exception of documentation. The project leader tended to view successful implementation as getting the programs running, the documentation finished, and the procedural flows correct so that his system worked. Turnover, although very limited in the sample, was seen as standing in the way of easy implementation, as was pressure to rush a project to completion.[1] Reported complexity of the project was also negatively related to the ease of implementation, but it was difficult to determine which way this relationship went. It could be that project leaders viewed as complex those projects which were difficult to

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[1]Although not significant at the .10 level, implementation problems (Var. 58) was negatively related to project control (Var. 42) with a tau of -.307 and a normal deviate of 1.683, significant at the .102 level (two-tailed).

implement. Finally, where documentation was felt by project leaders to be good, implementation problems were felt to be less.

Although not entirely accurate, one generalization which might best describe the differing views of implementation problems is that project leaders tended to view implementation up to operational cutover of a project, while the users looked at implementation as what happened after operational cutover.

Project Leader's Perception of User Participation

In general, the project leader felt there was high user participation if a project team consisting of some user representatives developed the project, and if he perceived top level user management had actively supported the project. Most of the relationships in Table 45 represent either these two basic variables or other variables already shown to be related to them. Further, the project leader tended to feel that the user had stated clear and specific project requirements where there was a high level of user participation, as indicated by the fact that most of the variables shown in Tables 44 and 45 are the same.

On the other hand, the users' evaluation of the specificity of their original desires and requirements was related to a separate group of variables as shown in Table 46. This evaluation was not significantly related to the project leader's view of ostensibly the same factor, specificity of user requirements. It appeared that users felt they had to

be more specific in stating what they wanted in larger organizations to get their projects accepted. It also appeared that the users were more accurate than project leaders in their appraisals of how clearly they stated exactly what they wanted from projects. Although not significant at the .10 level, the users' view of specificity of their requirements (Var. 45) was related to the time success criterion (Var. 48) with a tau of -.272, a normal deviate of 1.586, and a probability of .114. Further, there was a significant relationship between Variable 45 and both the elapsed months spent on the project, and the project leader's appraisal of time success.

TABLE 44

Specificity of User Requirements-PL (Var. 38)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Project Team	14	.750	3.032	.0027
User Man Months/ Total Man Months	15	.562	3.073	.0022
User Participation-PL	41	.562	3.036	.0025
Implementation Problems-User	53	.419	2.290	.021
User Satisfaction-PL	57	B.409	2.116	.036
User Participation-User	46	.400	2.160	.030
Project Success-PL	56	.367	1.937	.052
User Management Interest	39	.320	1.675	.094
Two or More Years Systems Experience	27	-.450	2.435	.014

TABLE 45

User Participation-PL (Var. 41)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Project Team	14	.660	2.603	.009
Specificity of User Requirements-PL	38	.562	3.036	.0025
User Man Months/ Total Man Months	15	.539	3.233	.0014
User Management Interest	39	.453	2.332	.020
User Satisfaction-PL	57	.394	2.135	.032
User Participation-User	46	.367	2.174	.030
Measurable Project Objectives	12	.344	1.830	.068
Two or More Years Systems Experience	27	-.361	2.141	.032

TABLE 46

Specificity of User Requirements-User (Var. 45)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Employees	3	B.405	2.316	.020
Time Success-PL	49	.394	2.114	.034
User Participation-User	46	.356	2.111	.034
Elapsed Months	21	-.300	1.756	.080
College Degree	5	-.333	1.977	.048

On the assumption that clear, specific, and detailed user requirements provided the project staff with a more concrete nucleus around which to build the project, time success should have been greater. The data would appear to support this contention.

User participation (Var. 46) also appeared to be greater when users felt they had been very specific in stating their requirements. As was mentioned at an earlier point, where the users were able to state exactly what they wanted from a project, they apparently felt they had control of what was developed, and, therefore, that they had high participation.

It may strike the reader as odd that there was no relationship between reported specificity of user requirements (Var. 45) and user satisfaction (Var. 54). However, a close investigation revealed three projects, termed "evolutionary", which were low on Variable 45, but high on user satisfaction (Var. 54). There were also three projects which were high on Variable 45, but very low on Variable 54, a result, apparently, of users not getting what they had specified as required. These several projects, in effect, "cancelled out" any relationship between specificity of user requirements (Var. 45) and user satisfaction (Var. 54) in the computation of the tau statistic.

In summary, whereas the project leader appeared to base his evaluation of the specificity of user requirements

on the degree of user participation in the project, the users seemed to base the appraisal of their participation, in part, on how specifically they stated their requirements in the first place. There were cases, however, where users were not specific in stating their requirements, but felt they participated through an evolutionary process of trial and error over a relatively long period of project development. Finally, users and project leaders did not tend to agree on the degree of specificity in original project requirements, but the data suggest that perhaps the users' appraisals were more accurate than those of project leaders. This last point, on the accuracy of appraisals, should be researched more thoroughly, however, before any firm conclusion is drawn.

Quality of Documentation

For the projects in the study, the perceived quality of documentation was not related to the presence or absence of documentation standards. Again, it is emphasized that only four projects were developed without documentation standards, so it would seem unreasonable to conclude that documentation tends to be as good without standards as with them. However, it did appear that the mere presence of standards was not enough to assure high quality documentation.

As shown in Table 47, the perceived quality of project documentation was related to several other variables. It has already been pointed out that both users and project leaders

perceived fewer implementation problems where documentation was of relatively high quality. This finding was not unexpected.

TABLE 47

Quality of Documentation (Var. 36)

(Two-tailed significance at or beyond .10 only)

	Var.	Tau	Z(s)	P(Z)
Implementation Problems-PL	58	.533	2.869	.004
Implementation Problems-User	53	.333	1.739	.082
High Level Programming Language	43	.300	1.780	.076
Man Months	22	-.327	1.663	.096
Project Control	42	B-.336	1.650	.10
Elapsed Months	21	-.340	1.736	.082

The relationship of perceived documentation quality to the use of higher level programming languages, essentially COBOL, has also been discussed. It appeared that most project leaders who used COBOL felt they had adequate documentation to allow reasonably easy program maintenance, which seems to have been their primary criterion for quality.

Finally, the perceived quality of project documentation was negatively related to the elapsed time on the project, the man months on the project, and reported project control. These rather weak relationships could be interpreted at least

two different ways. One interpretation would be that projects took longer because of poor quality documentation that occasioned delays, duplication, and general confusion. Another interpretation, which seems to make some sense, would be that where project control schemes were more stringent, pressure built up on project leaders and staffs as the project took longer or more man months were expended. The response to the pressure was to cut corners on documentation, concentrating on getting something running as quickly as possible. If the latter possibility were true, the control schemes used could have been dysfunctional to long range project success. Most of the prescriptive literature argues for both documentation standards, to assure high quality documentation, and project control techniques, to keep projects on target. They may not be compatible. This is a very interesting question which should be investigated by experimental means if possible.

PART IV

SUMMARY OF RESULTS, CONCLUSIONS, AND SUGGESTED FUTURE RESEARCH

CHAPTER VIII

SUMMARY OF RESULTS

Introduction

In Chapter I the purpose of the research described in this thesis was phrased as the question:

> What organizational and procedural factors are correlates of success with MIS projects?

In seeking answers to that question, the literature on MIS, project management, and information systems in general was reviewed. While few satisfactory answers were found in the literature review, a set of thirty-five hypotheses was developed which, it was hoped, could be tested.

The list of hypotheses was pared down from thirty-five to sixteen after analyzing the responses of information systems professionals to a request to rank the thirty-five hypotheses, or factors, in terms of their importance to MIS project success. These sixteen hypotheses, along with four criteria of MIS project success, then became the nucleus of a questionnaire which was developed for interviewing people in organizations who had been involved with MIS projects.

A successful pre-test of the questionnaire was followed by the selection of a study sample. Ten organizations from the Twin Cities, representing seven industries, were chosen for the study. Data were collected on two MIS projects in each of these organizations between October and mid-December, 1970.

The data collected were analyzed to determine what relationships existed among variables in the study. The primary form of statistical analysis was the computation of Kendall's rank correlation statistic, tau, for every possible relationship between any two of the sixty-one variables identified in the study.

The results of the data analysis have been discussed in detail in Chapters VI and VII. This chapter is devoted to summarizing the findings of the study. The final chapter, Chapter IX, will be devoted to drawing conclusions from the results, and to suggesting some possible future research directions based on what has been found here.

Independence of Criteria of Success

Four criteria of MIS project success were posited and used in this study: time success, cost success, user satisfaction, and computer operations success. These four criteria were found to be reasonably independent measures of MIS project success. The closest relationship found between any two criteria was that between user satisfaction and computer operations success. This would seem to be a logical relationship. Where a project impacts on computer operations in such a way that scheduling and running problems develop, the users probably feel such problems through inadequate response and service from the information systems function.

Findings: Tests of Hypotheses

Hypotheses Related to Criteria of Success

Of the sixteen hypotheses which were selected to be tested in the present study, one was not effectively tested by the sample data, ten were found to be significantly related to at least one criterion of success, and five were found to be unrelated to any criterion of success. The hypothesis which was not tested, and about which no conclusions could be drawn, was the degree of relationship between centralization of the information systems function and MIS project success.

The ten hypotheses which were tested and found to be related to project success are shown in Table 48. For each entry, the rank of the hypothesis, in terms of its importance to project success, from the original ranking of thirty-five hypotheses is shown first; next is shown the hypothesis itself; and shown last are the separate criteria to which the hypothesized factor was related. A "+" in the table indicates that the factor contributed to success on the criterion in question, and a "-" indicates that the factor detracted from success on the criterion in question. Tables 16-19 in Chapter VI should be consulted to find the strengths of the relationships shown in Table 48, and to determine the variable numbers used in the study to represent the hypotheses. Further, the discussions in Chapter VI concerning Tables 16-19 should be referenced for interpretation of the relationships.

TABLE 48

Summary of Findings

Rank	Hypothesis	Time	Cost	User Satis-faction	Computer Operations
1	Participation by operating management in design, formal approval of specifications, and continual review of project.			+	
7	Organization level of top computer executive.	—			+
12	Documentation standards used and enforced.	+			
14	Low turnover of project personnel.			+	
16	Source of origination of project (MIS staff or user).			+	
20	Length of experience in the organization of project personnel.	—		+	
23	High level programming language used for project.	+			
31	High formal educational level of project personnel.	—			+
32	Separation of analysts and programmers for large projects.	+		—	
33	Overall size of organization systems staff.	—	—	+	

Hypotheses Not Related to Criteria of Success

The five hypotheses found to be unrelated to project success for the projects in the sample were:

Rank	Hypothesis
2	Measurable project objectives from conception of the project.
3	Utilization of a project team composed of MIS staff and user personnel.
8	Systems experience of project personnel.
13	Use of a formalized and regular reporting structure on project progress.
34	Ratio of computer hardware investment to total sales or operating budget.

General Comments Concerning the Hypotheses

In reviewing the above findings from the study, one impression that immediately comes to the fore is the error in the evaluations of the information systems professionals who ranked the thirty-five hypotheses in terms of contribution to project success. More of the hypotheses were confirmed from the lower half of the ranking than from the top half. In other words, those factors which the information systems professionals thought most crucial to MIS project success tended to be rejected more than those factors thought least crucial. However, the questions and possible explanations arising from this situation are more interesting than the situation itself.

A fundamental benefit to the researcher in conducting this study was that the general confusion which surrounds the

definition of MIS was brought into clearer focus. That there is rather widespread disagreement among those in the information systems community concerning what MIS really is, or ought to be, became apparent in analyzing the responses of the information systems professionals who attended the Founding Conference of Society for Management Information Systems in 1969 to a request to define what MIS meant to them. The different definitions of MIS were almost as numerous as the respondents themselves (Dickson, 1970).

The researcher tried to avoid this confusion from the beginning of this study by concentrating on MIS projects, and by defining rather explicitly the criterion which placed a project in the management information system category. Very simply, any project selected for study had to result in information being provided to a manager, at some level, which was used by that manager in the decision-making process relative to his domain of responsibility. The emphasis throughout the study was on looking at projects which had been conceived to furnish managers information that would assist them in making decisions in a more effective way.

The conclusion reached during the course of the research was that there are at least three different types of computer-oriented information system projects which should not be lumped together. These three are:

1. Data processing projects, where the basic objective is to process operational data in a more efficient manner by using a computer in lieu of manual or accounting machine methods.
2. Generalized software projects, where the objective is to produce a marketable software package for widespread consumption by various users. There is no explicit concern here for the specific information needs of one or a few users in one organization, although the products of such an endeavor might facilitate responding to those needs after further development, modification, or incorporation into a user-oriented system.
3. Management information system projects, where the objective is to provide a manager, or managers, with specific information system products that will enable those managers to do a better job of decision-making relative to specific kinds of problems.

As has already been pointed out, this research has focused entirely on category 3 above. However, the specification of a definition for the purposes of this study can in no way be expected to go beyond the bounds of this study. In other words, although a definition of MIS projects has been provided which has suited the purposes here very well, it is only one of many

possible definitions. The data and results presented in this thesis are relative to only one portion of the information systems spectrum, and where factors were ranked by others in the field as to their importance to MIS project success, other frames of reference were possible. Therefore, to say that the conclusions reached here serve to reject the general thinking of professionals in the information systems field as to what factors are critical to MIS project success would be an error.

With that background, several further comments can be made about the findings and conclusions presented here. Since the entire focus of the present study has been MIS projects, as they have been defined, all of the findings must be viewed in that context. The size and scope of projects, how they were managed, the interactions that occurred, and measures of success must all be considered in the context of the MIS project. This means that generalizations beyond this type of project should only be made with the greatest caution, if at all. This is not to say that the findings here are of no consequence because they don't apply to the entire information systems spectrum. Rather, other portions of that spectrum must be investigated separately, or at least with an awareness that there seem to be fundamental differences in what one is looking at. However, even this last statement cannot be confirmed until these other segments of the information systems spectrum have been analyzed in somewhat the same way that MIS projects have been analyzed in this study.

The User Participation Cluster

It was definitely concluded from the analysis of the data collected in the study that perceived user participation is a crucial factor in the success of MIS projects. There was a cluster of variables that seemed to represent, essentially, the direct and close involvement of users in the development of their projects. This cluster consisted of origin of the project, reported clarity of objectives, reported specificity of actual information requirements, the use of an interfunctional project team, and finally, the user participation variable itself. However, making this general statement necessitates explanation of several points with respect to success and the separate variables just cited.

First, there is an implicit value judgment that user satisfaction with a MIS project is the most important success criterion. This is based on the nature of the MIS project as opposed to other possible project types. Since the primary purpose of the MIS project is to provide information to a manager to support his decision-making responsibilities, the failure of a project to satisfactorily serve this end means failure for the project in terms of its essential purpose. Being within budget on time and cost, and creating no problems for computer operations, are hardly meaningful if the completed project is not used or is viewed by users to be inadequate for their information needs. This is not an advocacy of

complete freedom from budgets or the need to consider how a given project will affect computer operations. It is merely a value hierarchy of the criteria, with user satisfaction as the primary criterion and the other three as important, but secondary criteria of success.

Moving to a closer consideration of the variables included in the cluster mentioned above, several important aspects of perceived user participation were brought out in the analysis of sample data. First, although clear and measurable project objectives would logically seem to be a big factor in users getting what they could use, and within time and cost expenditures reasonably close to budgets, this was not always the case. In fact, there were enough projects in the study which did not follow this logical pattern that the nature of project objectives was not significantly related to any criterion of success. Those projects which did not fit the expected pattern were of two types: projects of the "evolutionary" type, and projects where users knew what they wanted to be able to do, but did not understand their own information-decision environments well enough to know how to do it.

In the first type, the "evolutionary" project, objectives were often reported to have been rather vague at the beginning of a project, but the users worked so closely with the project staff that, over a fairly long period of time, during which the users progressively learned more about what

information they could use and in what ways, results were generated with which the users were highly pleased. In the second type, where it was reported that there were clear and measurable project objectives, but where the users were not able to specify precisely what information they needed, or in what form, to reach those objectives, a good deal of frustration and slippage occurred during project development. It would seem that in these cases a project was begun before enough spadework had been done by users. In an effort to turn something out the project staff, after floundering for a length of time, froze requirements which may or may not have been what the users ended up feeling they should have gotten from the project.

With respect to the source or originator of a project, those initiated by users were generally more successful. The users usually knew what they wanted, and were thus able to work with project staffs in getting it. However, where users initiated a project, but then did not participate very much in the development efforts, results were poor. While the lack of user participation may have resulted, in part, because the project leader did not allow it, the major problem appeared to be users who were unwilling to contribute in a meaningful way. As a consequence, the project leader made decisions by default which affected the acceptability of the final products in the eyes of the users.

From the preceding comments one draws the conclusion that some organizations, and some individuals in organizations, have not come to recognize a difference between MIS projects and data processing projects. This situation was nowhere more apparent than in the findings regarding the use of interfunctional project teams. While teams did appear to enhance user participation, there were cases where the team approach was implemented in such a way that project success was marginal, if not poor. There were enough of these cases that project success and the use of teams were not significantly related to each other.

It was found that merely setting up a project team with users represented does not insureparticipation of the ultimate users of project outputs. In several cases, the data processing orientation seemed to dominate. It was assumed by user management, erroneously, that merely having someone on the project staff from the user area meant there would be high participation, and the user management would end up with satisfactory results. This approach may have served quite well for data processing projects, where the primary focus was on getting procedural aspects of an operational function cut over to the computer. A staff specialist from the user area who knew the procedures, records, and so forth, could do an excellent job for the user function in working as a member of the data processing project staff. However, where the project is primarily oriented to providing a manager with information to

assist his decision making, that manager, not the staff specialist, should be the one involved. The fact that in some cases this did not occur gave rise to the disagreement found among user personnel interviewed about the same project. The staff person from the user area felt he had participated heavily, and the results of the project were very good, whereas a manager, who was actually receiving the project outputs, felt participation was not so high and the results were not so good.

Another problem, related to the one just discussed, was the case of the projects where the user representatives who worked on the project staff were not the people who actually implemented the project. For one reason or another, the user representative was given other tasks, not directly related to the MIS project studied, soon after the project had been completed. This meant that people unfamiliar with what had transpired during project development were forced to implement the project, and to maintain continuing liaison with the information systems function. The results, not unexpectedly, were rather poor. The situation just described occurred either because the user representatives on the project team were staff personnel who were put on something else as soon as the project was completed, or the managers who had wanted the project developed, and worked with the project team, were transferred shortly before or after project implementation.

The Project Management Cluster

Three variables were viewed as comprising a project management cluster: documentation, project control, and the choice between separate or combination analyst/programmers. All three of these factors have been subjects of considerable discussion in the information systems literature, as pointed out in Chapter II. It would appear that much of the clamor surrounding these three factors has arisen as a result of the difficulties experienced with the development of data processing projects and generalized software projects. However, no distinction has generally been made among the different kinds of project environments in prescribing what those involved in developing computer based systems should do. The implicit assumption seems to have been that all projects are essentially the same, and, therefore, the same nostrums which were believed to be useful in remedying data processing and generalized software development ills would be applicable in the management information system environment.

There was certainly no evidence in this study which leads one to advocate anarchy in the management of MIS projects; which nudges one toward the conclusion that project management efforts are futile and should be abandoned. However, there was evidence to support the position that MIS project management should be considered in the MIS context. Unfortunately, in this regard, about the best the data analysis from this

study can do is raise some questions which need to be investigated thoroughly.

What are these questions that analysis of the data collected have brought to focus? First, is the issue of assigning separate analysts and programmers to a MIS project versus assigning one person who performs both functions. This, of course, does not mean that only one person would be assigned to a project in all cases; rather, that the project would be divided into functional modules where one individual takes responsibility for all analysis and programming involved for assigned modules.

Over the past several years, the sentiment has shifted from time to time as to which approach should be used; at no time has there been general agreement on which approach is best. There have been advocates in both camps. It would seem that this issue, as with the others raised in this chapter, is one without a universal solution. What is "best" probably depends on the organization and information system environment.

At least for the MIS environments of organizations sampled in connection with the research reported here, the use of combination analyst/programmers tended to yield the best results in terms of user satisfaction with project products. This seemed to stem mainly from the ability of the combination analyst/programmer to respond more quickly and effectively to

user requirements and problems. Where the user was able to deal with one person who had the whole picture with respect to one or more functional modules of a project, the user appeared to be more confident of what he could expect from the information systems staff and tended to be less frustrated by the implementation problems that arose.

To say that all MIS projects should be developed by combination analyst/programmers would, of course, be an unreasonable conclusion to reach. Several organizations had, in effect, a dual system, where some combination analyst/programmers were used, but where newer personnel, trainees, were also used as programmers only. This approach seems to have some merit, in that new people must be trained by some means. The question that should be raised, however, is whether or not this is the most effective means of training new systems people. This issue should be investigated, because it is possible that user satisfaction with MIS project results may be adversely affected where the separate analyst/programmer approach is utilized as a means of training new people. The important point is for the management of the information systems function to be aware of this possibility, so that safeguards can be built into project management to minimize adverse impact on user satisfaction with project results.

A second aspect of MIS project management which would seem to require a reappraisal is project control techniques.

For the projects in the sample, the project control variable was not related to any criterion of success, and it was negatively related to the project leader's appraisal of documentation quality. These findings could be interpreted in several ways. However, an explanation that encompasses all of these findings on project control is simply that the methods of project control were not conceived nor applied in the MIS context.

Where stringent progress reporting against planned activities was required, that reporting did not, in general, result in actual control being exercised. In the case of only one project were additional resources committed to enable the project staff to achieve the target date for completion. In the other cases, progress information seems to have been collected for its own sake, with little apparent use made of the information for control purposes. Where target dates were revised backwards as a result of slippage, this was of value to those in the organization who were to be affected by the completed project, but such use of supposed control information would not seem to constitute the whole realm of project control.

On the negative side, where stringent project status reporting was required, project staffs seemed to have felt pressure to get programs running as quickly as possible. However, where they had no additional resources available to them, about all project staffs could do to ease the pressure was cut corners

on documentation and implementation preparations, and refuse to make changes requested by users. In other words, it appeared that project staffs were frustrated by control methods rather than helped by them.

The reader may feel that the application of pressure as a means of reaching target dates is useful, nonetheless; that without such reporting and pressure, projects could go on for longer periods than they already do. And it is certainly true that with respect to the projects in this sample which were subject to tight progress reporting requirements, the actual times may have been less than they would have been had there existed no progress reporting. It is impossible to resolve that question, of course. The really important point in all of this, however, is the relation of the pressure to the quality of the original project estimate.

It appeared to the researcher that project time and cost estimates were probably made relative to data processing projects rather than to MIS projects. In very few cases was there recognition at the beginning of a project that, in the MIS environment, managers must learn to use what they receive; that they may want to change the content or format of outputs as they go along to whatever is easiest for them to use or fits into their decision-making styles. Therefore, as a result of poor estimates in the first place, some project staffs were subject to pressure to complete projects within artificial time frames.

Finally, with respect to perceived quality of project documentation, and documentation standards, no significant relationship was found between these two variables. Although 80% of the projects in the sample were subject to some form of documentation standards, the perceived quality of documentation was not assured by such standards. It should be pointed out that a weakness of the present study was the absence of any objective measure of project documentation which would allow the comparison of all projects against the same specifications. However, the evaluation of project documentation by project leaders was valid to the extent that projects free of documentation problems did seem to meet a functional test of documentation effectiveness. The assumption was made that where there were no documentation problems perceived by those who were using the documentation, the documentation met the functional test of quality.

The above conclusions are not intended as a case for no standards or no control with MIS projects. Rather, the point to be made is that both control and documentation standards should be conceived and applied to MIS projects with an explicit recognition that the MIS project is different from the data processing project or the generalized software project. Documentation standards should be oriented to providing clear understanding among all those concerned with a project, rather than to fixing responsibility for who said what to whom. The whole thrust of the standards should be toward making it easier

for evolution with users to occur rather than inhibiting it. The standards should be such that change is facilitated, rather than prevented through freezing requirements too rigidly at some arbitrary point. Project documentation is certainly no less important because the project is oriented to providing information to managers to assist their decision-making. This was borne out by the relationships between the perceived quality of project documentation and both users' and project leaders' views of implementation problems. However, the kinds of documentation standards which have been applied do not appear to be the most effective for assuring the type of documentation needed with MIS projects.

The same sort of argument holds for project control methods. All control should not go out the window because the MIS project is somehow different from the kinds of projects control schemes have been devised to handle. In fact, it is quite possible that MIS project control will provide a greater challenge to information systems managers than data processing projects have. Where time estimates cannot be fixed as easily, and where several projects are running at one time in various stages, the allocation and control of resources will likely be more difficult. But the point is, that if managers are to derive truly usable products from MIS projects, they should be allowed to grow and experiment with results. This means a more fluid situation where estimates

are not based on just the apparent facets of a project at original definition. The estimates will also have to be based on the kinds of products involved and the individual situations of the managers who are to be served. The notion of many open-ended projects, current over a long period of time, may seem to be an impossible situation with which to live. But what is the point of imposing artificial constraints from another environment on MIS projects, only to achieve time and cost "success" for results that are ineffective or not used?

The Project Leader's View of Project Success

It has been argued here that the most crucial criterion of MIS project success is user satisfaction with the results of the project. How do project leaders view project success? It would appear, based on the sample data, that project leaders implicitly, if not explicitly, understood the ascendency of user satisfaction over other criteria for MIS projects. Project leaders' perceptions of project success were related very strongly to how satisfied users were with project results. Further, project leaders clearly recognized the great importance users attached to implementation problems. Where users were able to use project outputs with relative ease, project leaders felt the projects were successful. Most project leaders also seemed to recognize that cluster of user participation variables, so important to user satisfaction, as important in contributing to project success from their own

viewpoints.

While project leaders did accord time success some importance in evaluating overall project success, this was secondary to user satisfaction. Further, the project leader's view of project success was not significantly related to either cost success or computer operations success. In short, project leaders were keenly aware, in most cases, of how the users felt about projects, and these users attitudes were the most important key in how successful the project leaders felt the projects were.

Differing Views of Users and Project Leaders

Although users and project leaders agreed very well on what made MIS projects successful, they disagreed on two important aspects of MIS projects. Project leaders appeared to consider implementation problems as those difficulties encountered in getting a project completed and operational. They tended to focus on cutover as the crucial point, and where problems arose in making the cutover, they felt there were implementation problems. Users, on the other hand, seemed to focus on problems in using the project products as implementation problems. They tended to look at implementation as what occurred after cutover; those problems experienced in trying to work with what had been developed to assist them in their decision-making roles.

This finding may appear to be a contradiction of what was said earlier concerning the project leader's perceptions of success, and how those perceptions were strongly related to users reporting few implementation problems. However, there really is no contradiction. The project leader, nurtured in the data processing environment, tended to look upon implementation as getting a set of programs up and running. Once this was accomplished, and programs were reasonably free of obvious bugs, he and his staff went on to something else, new projects. Users, on the other hand, had to live with what had been given them. No matter how free of technical bugs a program was, users had to try to use what they received. Where there was no follow-through by the systems staff in helping users to do this, users became frustrated and felt there were implementation problems. Although project leaders seemed to be aware of the frustrations and problems felt by users, and recognized these frustrations and problems as important factors in how well satisfied the users were, the project staffs were often already committed to other projects. This meant that although they recognized that follow-through, and perhaps changes, were necessary to help users get the kinds of information needed, they were not free to do anything about it.

A second area where users and project leaders disagreed to some extent was in evaluating how specific original user requirements had been. The project leaders tended to lump

specificity of user requirements in with the cluster of user participation variables, whereas users appeared to evaluate, in retrospect, how clearly they were able to state what they wanted at the beginning of the project.

The evaluations by users of how specifically they had stated what they wanted were probably colored by the growth process in working with outputs. It appeared that users tended to be less satisfied after a period of working with a project than when the project was just completed. This was interpreted as a reflection of user learning. Thus, when the user was interviewed, his feeling that he was not presently getting what he would really like to have probably influenced his judgment of how clearly he had stated what he wanted in the first place. He seemed to assume that if his requirements were not now being satisfied as well as he would like, he had done a poor job of saying what he wanted. This, of course, was not necessarily the case, because the user may have stated fairly well what he wanted when he started. But through the experience of using project outputs to do his job, his requirements had shifted to some degree.

The project leader, from his perspective, was concerned with trying to pin requirements down so something could get programmed. The fact that he had users working with him on a team, or readily available to work with his staff if not on a team, probably facilitated his getting specific

requirements defined. The fact that the project leader sought to pin down requirements was natural; it was his job to do so. However, the error was in assuming those requirements would not shift after the project was implemented. It should not be construed that this was necessarily the project leader's error. The very nature of most data processing environments precluded his going very far beyond implementation. The evolutionary approach was not recognized nor built into the development process.

CHAPTER IX

GENERAL CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

General Conclusions

The most fundamental conclusion drawn as a result of conducting the research reported here is that different environments exist for different kinds of information system projects. While this may sound like a truism, and a very superficial result of an extensive research effort, the implications of that conclusion pervade virtually all of the findings. If professionals in the information systems field know that different kinds of projects do exist, and that they should be treated in different ways, that knowledge is not readily apparent in either the literature of information systems or the practice of those whose vocation is information systems.

It was stated in Chapter VIII that at least three different types of information system projects appear to exist. These three types of projects would all seem to place different kinds of requirements on those responsible for managing their development. The present study was devoted solely to MIS projects, so conclusions should not be generalized to other types.

With MIS projects, the primary objective is to provide information to managers which they can use effectively in

carrying out their decision-making responsibilities. For this reason, the satisfaction of the manager with the results of the MIS project should be viewed as the most important criterion of project success. Time success, cost success, and computer operations success, while important, are secondary to user satisfaction.

To achieve success with MIS projects, the findings in this study suggest the following approaches to managing project development:

1. Adopt the evolutionary concept of project development. This implies recognition of a learning process among users which may only begin, but is certainly continued, after the project has been initially cut over and the user is receiving outputs. Where the main objective of a project is to enable a decision-maker to function more effectively, the decision-maker must be given the greatest precedence in project development plans. Projects should be considered from their conception as rather fluid, with provision for a trial and error process of growth on the part of the user. The project should not be viewed, in most cases, as a one-shot development effort

which has a specific end point.

2. Because of the nature of the MIS project, follow-through by the information systems staff is imperative. Close involvement with the user should not terminate upon initial cutover, but should continue to be supported by systems staff resources over a fairly long period of time. It would be expected that this resource commitment would decline as the user gains experience and confidence with the project outputs. Changes to project outputs would tend to be greater at first, decreasing in scope as the manager sights-in on what is really the most valuable information to him.

3. Project management should be oriented to the requirements of MIS projects, as opposed to attempting to manage all information systems projects the same way on the implicit assumption all types are essentially alike. Documentation standards and project control techniques should be devised which allow evolution rather than thwart it. Time and cost estimates should be made in light of

the evolutionary concept, and should not be used as cudgels to speed program conversion to free resources for other purposes.

4. Wherever possible, combination analyst/programmers should be utilized to facilitate user satisfaction. The ability of the user to look to one person who can respond knowledgably and quickly to his problems is important, and it would appear that the combination analyst/programmer is better able to do this than individuals who have done only analysis or programming work on the project.
5. Large projects which cover several functional areas should be avoided. Such projects would seem to be too inflexible for MIS, and too far removed from individual users. Blumenthal's (1969) framework for MIS projects would seem to be an appropriate model to follow; large systems could be broken into small modules, which are both more manageable, and more meaningful for users. The large underlying projects which are needed to support MIS projects could be approached as either data processing projects or generalized software projects. An example of the latter would be

a generalized file management system which can support many different MIS projects.

6. User participation means just that; those who are participants in MIS project development should be the managers who will use the products. The technique of assigning a user area staff analyst to the project team was fine for data processing projects where the primary requirement was for user area procedural knowledge and expertise. However, the MIS project focuses on the manager and his information needs. The definition of those needs should not be left to someone else if the manager is to be satisfied with what he gets.

The author has no delusions concerning the difficulty of following the above suggestions. No specific steps have been outlined which make it easy to implement any of these things. And, there is no guarantee that the separate suggestions, if followed, will bring success. However, the important findings of this exploratory study are that organizations should move towards different sets of ground rules for MIS projects than have been prescribed for data processing projects or generalized software projects. The objective of user satisfaction should guide the thinking of information systems managers as they seek

more effective ways to use the computer in their organizations.

Suggestions for Future Research

It is believed that this study has pointed up several areas requiring more explicit and intensive research; areas which, if researched, should provide some answers to the thorny problems inherent in pursuing the course that has been outlined above. Among the issues raised here which should be investigated thoroughly, and by experimental means, if possible, are:

1. The kinds of information used by managers in making decisions concerning their domains of responsibility, and the places they get such information now.
2. The effects of various project control schemes on project staffs; the tradeoffs among maintaining order, dysfunctional pressure, and willingness to adapt to user desires which may put the project in conflict with the control scheme.
3. Related to 2 above would be research on the reward structures in various organizations as they affect systems personnel engaged in developing MIS projects. What kinds of organizational rewards are tied to explicit and implicit organizational objectives?
4. Techniques for allocation and management of information systems staff resources where

projects do not "end" at an initial, clear cutover point. This would encompass techniques for estimating project time in the evolutionary approach.

5. Techniques for integrating managers into the development efforts on projects intended to provide them with information for decision-making. What different approaches are possible, and most effective, in getting managers to accept the kind of communication required in following the evolutionary concept of MIS project development?
6. If combination analyst/programmers should be used to develop MIS projects, how might new systems personnel best be trained to minimize deleterious effects on user satisfaction?
7. What are correlates of project success for other kinds of information system projects, such as data processing projects and generalized software projects? In these other project environments, what should be the criteria of success, and how should those criteria be viewed in terms of importance?
8. What kinds of project documentation are most crucial to MIS project success? Is it possible

to devise measures of documentation quality which can be applied objectively to all MIS projects studied to allow comparisons across projects and organizations?

9. Is there a means for evaluating MIS project complexity on an objective basis allowing comparison across project and organization boundaries?

Most of the above nine areas of suggested research are broad. However, if the present research has brought these issues into clearer focus so that further research can be conducted which will provide meaningful insights into the management of management information systems, an important objective has been achieved.

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APPENDIX A

SMIS QUESTIONNAIRE

One of the most important areas in the MIS field is that of the management of MIS projects. Below are listed a number of factors which can influence the overall success of MIS projects. We would like to have your opinion concerning how these factors influence MIS project success.

We recognize that "project success" is a vague term. For this reason we prefer that you use your own definition and frame of reference for making responses. Likewise, "project" is vague; so assume that it refers to a development effort on the part of EDP and/or user personnel requiring at least six man-months to complete.

Directions:

Please evaluate each of the thirty-four listed factors in terms of the factor:

"Performance standards employed for analysts
and programmers"

In other words, is any given factor cited below - more, less, or of equal importance - in determining MIS project success than is "performance standards for analysts and programmers." Please check the appropriate blank for each factor.

Standard factor: "Performance standards employed for analysts and programmers"

	Importance compared to standard:				
	much less	somewhat less	about same	somewhat more	much more
1) High formal educational level of project personnel.	____	____	____	____	____
2) Proficiency of project personnel as judged by superiors. . .	____	____	____	____	____
3) Length of experience in the organization of project personnel	____	____	____	____	____
4) Systems experience of project personnel	____	____	____	____	____
5) Coordinating ability of project leader (superior's evaluation).	____	____	____	____	____
6) Persuasiveness of project leader (superior's evaluation).	____	____	____	____	____
7) Low turnover rate of MIS Dept. Staff	____	____	____	____	____
8) Low turnover of project personnel	____	____	____	____	____
9) High average income level of MIS Dept. Staff	____	____	____	____	____
10) High rates of MIS Dept. Staff drawn from within the organization.	____	____	____	____	____
11) High availability of computer time for program testing. . . .	____	____	____	____	____
12) Program maintenance and review responsibility specified for definite period after implementation	____	____	____	____	____

Standard factor: "Performance standards employed for analysts and programmers"

	Importance compared to standard:				
	much less	somewhat less	about same	somewhat more	much more
13) Measurable project objectives from conception of the project	____	____	____	____	____
14) Formal project selection process used to determine which projects to develop. . .	____	____	____	____	____
15) Separation of analysts and programmers for large projects	____	____	____	____	____
16) Combination analyst/programmer for small projects	____	____	____	____	____
17) High level programming language used for project.	____	____	____	____	____
18) Formal training program set up for user organization . . .	____	____	____	____	____
19) Number of years experience for organization with computerized information systems . . .	____	____	____	____	____
20) Documentation standards used and enforced	____	____	____	____	____
21) Utilization of a project team composed of MIS and user personnel.	____	____	____	____	____
22) Organizational level of top computer executive	____	____	____	____	____
23) Source of origination of project (MIS staff or user) . . .	____	____	____	____	____
24) Participation by operating management in design, formal approval of specifications, and continual review of project	____	____	____	____	____

Standard factor: "Performance standards employed for analysts and programmers"

	Importance compared to standard:				
	much less	somewhat less	about same	somewhat more	much more
25) Operating management conducts periodic management audit of MIS function. (Evaluation of effectiveness for users) . . .	____	____	____	____	____
26) Utilize existing data base versus constructing or greatly modifying one.	____	____	____	____	____
27) Short-term, minor project versus large, complex project.	____	____	____	____	____
28) Planning and accounting for all resources throughout project development	____	____	____	____	____
29) Utilization of a formal time-scheduling technique such as PERT for project development .	____	____	____	____	____
30) Use of a formalized and regular reporting structure on project progress.	____	____	____	____	____
31) Ratio of computer hardware investment to total sales or operating budget.	____	____	____	____	____
32) Overall size of organization systems staff.	____	____	____	____	____
33) Low degree of overall organizational change.	____	____	____	____	____
34) High centralization of organizational MIS activities. . . .	____	____	____	____	____

[illegible]

Please list any other factors which you believe are important to the success of a MIS project.

____

____

____

____

____

APPENDIX B

CC
1______
2______

QUESTIONNAIRE FOR STUDY OF SUCCESS/FAILURE CORRELATES IN MIS PROGRAMMING PROJECTS

I. Environmental Factors

A. General Information - Company or Division

1. Basic Industry:

a. Manufacturing ______

(1) Consumer ______

(2) Industrial ______

3 b. Wholesale, Retail Trade ______

c. Transportation ______

d. Financial ______

e. Utility ______

f. Other (indicate nature) ______

2. If Manufacturing, Primary Production Technology

a. Unit Job/Small Batch ______

4

b. Assembly Line/Mass Production ______

c. Continuous Process ______

3. Company or Relevant Division Size Data

5-11 a. Total Assets ______

12-18 b. Total Sales ______

19-23 c. Total Employees ______

24-26 d. Number of Billed Customers ______

27-29 e. Number of Products ______

30-31 f. Number of Manufacturing Locations ______

32-33 g. Number of Distribution Points ______

4. Have there been any significant organizational changes in last three years? (i.e., mergers, acquisitions,etc.)

34 (Circle one)

No significant changes		Several Minor Changes		Extensive Changes
5	4	3	2	1

5. What was the ratio of computer hardware investment to last

35-36 year's total sales or other gross income measure? (If rented, monthly rental x 40) ______

6. What proportion of the operating expenses of the information

37-38 systems function was accounted for by computer hardware last year? ______

7. Centralization of organization's information system activities.

a. If a new MIS application is proposed, which of the following statements best describes how the organization accomplishes the design, analysis and programming activities for that project? (Check one)

39

All design, analysis, and programming tasks are performed by the corporate MIS staff regardless of who originated the project. ______5

All design, analysis, and programming tasks are performed by the corporate MIS staff only if the project involves organizational segments other than the one proposing the project. (I.E., If a division has its own systems staff, and the project involves only that division's information needs, the division will develop its own programs within corporate guidelines.) ______4

General system design always done at the corporate level but analysis and programming performed by the organizational segment that wants the project accomplished. ______3

The corporate level MIS staff prescribes standards and procedures for project development, approves or disapproves project proposals, and evaluates MIS progress and performance. Corporate staff does not do the analysis and programming. _____2

The corporate MIS staff provides guidance, coordination, and assistance to organizational segments but all design, analysis and programming performed by the organizational segment. _____1

8. Level of the top computer executive:

a. What is the organizational location of the information systems function:

A separate function reporting directly to top management _____4

40 A separate function reporting directly to administrative VP or other similar executive. _____3

An organizational component of some other staff function such as the Controller. _____2

An organizational component of a line function (specify line function) _____1

b. How many hierarchical levels are there between the manager of the information systems function and the

41 top operating executive? (Circle one)

0 1 2 3 4 or more

42-44 9. How many personnel are employed by the company in the systems design, analysis, and programming activities? _____

II. Project Information

A. Provided by Project Leader or Information Systems Manager

1. Who originated this project?

User department	______4
Top level management	______3
Information systems staff	______2
45 Other (specify)	______1

2. Nature of the project:

   a. What functional area of the organization was the primary beneficiary of the project? ______

   (If the project had several primary beneficiaries, list them all.)

   b. Project leader's brief description of the nature of the project.

   c. Project completion date: __________

3. Objectives of the Project: (Check most appropriate statement)

   a. Specific measurable objectives were laid down in writing at the outset of the project. ______6

   b. Specific but non-measurable objectives were laid down in writing at the outset of the project. ______5

   c. General but clear objectives were laid down in writing at the outset of the project. ______4

   d. General objectives were agreed upon by key parties involved at outset of project but
46 not committed to writing. ______3

   e. Objectives of the project were rather vague at its initiation but were more fully developed later as the project progressed. ______2

   f. Project objectives were not quite clear to those engaged in the project. ______1

4. Project leader's rating of the relative complexity of the project: (Check one)

The most complex project I have been involved with in this organization _______ 5

One of the more complex projects we have undertaken _______ 4

47 About average complexity _______ 3

Less complex than many of the organization's MIS projects _______ 2

One of the least complex MIS projects we have undertaken___ 1

5. Was a project team composed of user personnel and information

48 systems staff utilized for this project? Yes _______1
No _______0

If yes:

a. Were user personnel full time or part time on the

49 project? Full time _______1
Part time _______0

b. What proportion of the project team was made up of

50-51 user personnel? _______

c. Of the total man months devoted to the project, what proportion were accounted for by user personnel?_______

52-53 d. When the design and programming effort was completed were the user personnel responsible for implementing

54 the project in their respective organizational areas?

Yes _______1
No _______0

e. Did the user personnel who worked on the project team

55 carry on the liaison with the information systems staff after implementation?

Yes _______1
No _______0

f. While on the project team, to whom did user personnel report as their superior?

56 Project leader ________3
Information system mgr. ________2
Regular superior ________1

g. By whom were user personnel evaluated?

Project leader ________3
57 Information system mgr. ________2
Regular superior ________1

h. In the opinion of the project leader, how instrumental were user members in contributing to project success? (Check one)

Very great contribution -- were critical to success ______5

Made some contribution; could not have done so well without them ________4

58

Their presence on the team didn't contribute much; could have done just as well without them ________3

Their presence on the team had a slightly negative influence, we had to train them, etc., slowed us down ________2

Their presence on the project team was detrimental to project success, created conflict ________1

59-60 6. How many people worked directly on the project? ________

61-62 Number of Analysts ________

63-64 Number of Programmers ________

65-66 User Representatives ________

67 Consultants ________

68-69 7. How many months elapsed from initiation of the project to implementation? ________

70-72 8. How many man months were spent on the project? ________

CARD #2

9. Were the analysis and programming functions accomplished by

1 separate groups or by personnel who were combination analysts/

programmers? Combination ______ 1
Separate groups ______ 0

10. Systems experience of project personnel:

2-4 a. How many months experience in systems work has the project leader had?

b. What is the mean length of systems experience (in

5-6 months) for project personnel, including user organization members if applicable? ______

c. Provide same information as for 9 (b) above

7-9 excluding user organization project members. ______

d. What proportion of the project staff had two or more years of systems experience at the beginning

10-11 of the project? ______

e. Project leader's appraisal of impact that prior systems experience of project staff had on project success:

High experience was critical to project success. ______ 5

12 Experience contributed somewhat to project success. ______ 4

Experience in systems work was not very important one way or the other. ______ 3

Experience had mixed effects; the high experience of some team members was very important, but was offset somewhat by inexperience of other team members ______ 2

On balance, the lack of systems experience was detrimental to project success. ______ 1

11. Project staff turnover:

a. What was the percentage turnover within the project staff during the course of the project? ______

(This should be calculated as follows):

13-14 $\frac{A + D}{2P}$ where:

A=the number of individuals added to the project staff as <u>replacements</u> for departed members

D=the number of individuals who left the project staff before the project's implementation for any reason besides completion of all assigned tasks.

P=the median number of individuals on the project staff.

b. Project leader's appraisal of the effect of personnel turnover on project success: (Circle one)

15

Very detrimental	Somewhat detrimental	Made no difference	Contributed to success
4	3	2	1

12. Project staff educational level:

16-17 a. What proportion of the project staff held college degrees? ______

b. What proportion of the project staff completed at

18-19 least two years of college or junior college? ______

c. What was the mean number of years of education for

20-21 the project staff? ______

(12 years for high school; 4 years for college, etc. Person with a college degree would have 16 years of education)

13. Organizational experience of project staff:

a. What was the <u>mean</u> number of years experience in this

22-23 organization for project staff members at the beginning of the project? ______

b. What proportion of the project staff had two or more

24-25 years of experience in this organization at the beginning of the project? ______

14. Documentation

a. Were formal documentation standards specified for or

26 applicable to the project?

Yes ______1
No ______0

b. Project leader's appraisal of importance of the documentation standards: (Circle one)

27

Made significant contribution to success		Somewhat useful		Were just make-work
5	4	3	2	1

c. Project leader's appraisal of compliance of the project staff with documentation standards:

Project staff followed standards completely; each phase of documentation required by standards was completed at the specified time during project development. ______5

Project staff followed standards for the most part; however, documentation was occasionally lacking in quality and timeliness. ______4

28 Tried to follow standards but just couldn't keep up with it and get the programming done, too. ______3

Standards were used for guidance mainly, not followed religiously. ______2

Did not follow standards; each project member did what he felt was required. ______1

d. How much time and effort were devoted to enforcing documentation standards? (Circle one)

29

Very great time & effort		Moderate time & effort		Very little time & effort
5	4	3	2	1

e. Project leader's appraisal of quality of the documentation:

30 Documentation was of high quality; experienced no problems because of inadequate documentation. _______4

Documentation was adequate in most cases; some problems of inadequate documentation did arise but they were very minor. _______3

Documentation problems were frequent but such problems did not seriously affect the success of the project. _______2

Documentation problems were serious; had a detrimental effect on success of the project. _______1

f. If documentation standards were not followed, was this a result primarily of: (Check one)

Unrealistic standards	_______
Inadequate standards	_______
31 Lack of time to document	_______
Lack of willingness to document	_______
Skip 32-33 Other (specify)	_______

15. Participation by user organization management in design, formal approval of specifications, and continual review of project:

a. What was the degree of the user organization's active participation throughout the evolution of this project?

34 (Circle one)

Very great	High participation	Moderate amount	They provided what was asked for	Almost none
5	4	3	2	1

b. What contribution do you feel user participation made to the success of this project?

User participation was definitely an important contributor to project success _______5

35 User participation probably contributed somewhat to project success _______4

User participation of no real consequence one way or the other _______3

The lack of meaningful user participation probably detracted somewhat from project success. _______2

The lack of meaningful user participation definitely had a detrimental effect on project success. ________1

c. How would you evaluate the quality of the communications between your staff and the user organization on this
36 project? (Circle one)

Highly constructive and effective	Good	Adequate	Somewhat inadequate	Poor
5	4	3	2	1

d. How clearly were user organizations' detailed requirements and desires specified at the outset of the project? (Circle one)

37

Very clearly and explicitly	Generally clear	Adequate	Not too clear	Very Vague
5	4	3	2	1

e. Was management at the top levels of the user organization interested in the project and in directing its evolution?
33 (Circle one)

Extremely interested and active participation		Interested but passive		Disinterested and passive
5	4	3	2	1

f. Were user organizations' desires for products of the project incorporated into the project as it developed even if
39 doing so entailed changes to what had already been accomplished? (Circle one)

Always	Usually	Half the time	Seldom	Never
5	4	3	2	1

Skip 40-41

16. Which statement most nearly matches the situation that existed for project control on this project?

There was a formalized reporting system which required that each project member report to the project leader his progress against assigned or planned tasks at least every month. ________5

42 No formalized reporting system was required by the organization but the project leader instituted his own; each project member reported his progress against assigned or planned tasks to the project leader at least every month. ________4

There was no regular progress reporting required of project members. However, the project leader was in frequent touch with all project members and thus kept the project status and progress records himself. ________3

There was no regular progress reporting required of project members. Project leader either occasionally asked project members how they were progressing or left it to project members to inform him if falling behind schedule. ________2

There was no task schedule set up against which to measure progress of project staff members. ________1

43 17. What programming language was used for this project?________________

18. Were there operating system or other generalized software

44 problems? (Circle one)

No problems	Minor problems	Major problems
3	2	1

B. Provided by User Personnel

1. User organization participation in the project:

45-46 a. How clearly were your organization's detailed requirements and desires specified at the outset of the project? (Circle one)

Very clearly and explicitly	Generally clear	Adequately	Not too clear	Very vague
5	4	3	2	1

47-48 b. What was the degree of your organization's active participation throughout the evolution of this project? (Circle one)

It was our project: very great	High participation	Moderate amount	Provided what was asked for	Almost none
5	4	3	2	1

c. Did you desire to have more of a voice in specifying and approving the products of the project than you

49-50 actually did have?

Couldn't have had more voice		Wanted somewhat more of a voice		Definitely did not have enough voice
5	4	3	2	1

d. How would you evaluate the quality of the communications between your organization and the systems staff

51-52 on this project? (Circle one)

Highly constructive and effective	Good	Adequate	Somewhat inadequate	Poor
5	4	3	2	1

e. Do you feel this project resulted in what you wanted or what the staff gave you? (Circle one)

53-54

Exactly what we wanted		About half and half		What the staff gave us
5	4	3	2	1

f. Did you make formal arrangements for liaison between

55 the project staff and your personnel?

Yes ______1
No ______0

56 g. Did you assign any person or persons in your organization responsibility for coordinating the project in your organization?

Yes ______1
No ______0

57 h. If answer to (e) was yes, did you relieve this person (persons) of normal duties?

Yes ______1
No ______0

Skip 58-60

III. Success Criteria
(A project is considered complete when turned over to computer operations)

A. Time
MIS manager or project leader

1. a. Was the project completed within the calendar
61 time originally allocated for it?
Yes ________ 1
No ________ 0

b. If completed on time, were additional staff
62 resources, over what originally were planned, required to do so?
Yes ________ 1
No ________ 0

c. If answer to (b) is yes, what percentage of the total project effort in man months was
63-64 accounted for by these additional resources? ________

d. If completed on schedule, was unanticipated
65 overtime required to do so?
Yes ________ 1
No ________ 0

e. If answer to (d) is yes, what percentage of
66-67 total project time in man months was overtime? ________

2. What were the actual man months required to complete the project as a percentage of man months originally allocated
68-70 to the project? ________

71-73 3. What was the actual project completion time as a percentage of allocated time? (elapsed time) ________

4. a. Did the project leader believe the time originally
74 allocated for the project was realistic?
Yes ________ 1
No ________ 0

b. If the answer to (a) is no, what did the project

leader believe to be a realistic time period for completion of the project (as a percentage of the time actually allocated - e.g., 120%) _______

5. If the time schedule was not met, what was the primary reason given by the project leader?

(Answer this question on the back of preceding page.)

6. Relative to past experience, how successful does the project leader feel this project was in terms of time

75 to complete it? (Circle one)

Highly successful	Above average	Average	Below average	Very poor
5	4	3	2	1

Card #3

B. Cost:

MIS Manager or Project Leader

1. Was the project completed within the original cost

1 budget for the project? Yes_______1
No _______0

2. What was the actual project cost as a percentage of

2-4 budgeted cost? _______

3. If the project exceeded budget, what was the primary reason for this in the opinion of the project leader?

4. Relative to past experience, how successful does the project leader feel this project was in terms of cost? (Circle one)

5

Highly successful	Above average	Average	Below average	Very poor
5	4	3	2	1

C. User Perceptions of Success of Project:
For each primary user organization-
For two levels of management in the user organization

1. How closely do the products of the project match what you wanted and expected from the project? (Circle one)

6-7

Got even more than expected	Good match	Satisfactory match	Marginal match	Poor match
5	4	3	2	1

2. Do you believe the originally stated objectives for the project were, or are in the process of being, satisfied?

8-9 (Circle one)

Definitely	For the most part	Not certain	Not very well	Definitely not
5	4	3	2	1

3. Overall, how satisfied are you with the products of the project? (Circle one)

10-11

Highly pleased	Well satisfied	Products acceptable	Products marginal	Dissatisfied
5	4	3	2	1

4. Have there been implementation problems associated with this project in your organization? (Circle one)

12-13

No problems	Very minor problems	Moderate problems	Considerable difficulties	Very serious problems
5	4	3	2	1

5. How well has this project been accepted by your organization? (Circle one)

	Enthusiastically	Good acceptance	Satisfactory acceptance	Marginal acceptance	Very negat-ively
14-15	5	4	3	2	1

6. What do you think should have been done to improve the effectiveness and value of the project with respect to your information needs?

16-17 7. Do you feel this project is completed? Yes_______1 No _______0

Skip 18-21

D. Project Leader's perception of Success of Project:

1. Do you believe the originally stated objectives for the project were, or are in the process of being, satisfied?

22 (Circle one)

Definitely	For the most part	Not certain	Not very well	No
5	4	3	2	1

2. Overall, how successful do you think this project was?

(Circle one)

23

Extremely successful	Very successful	Moderately successful	Not certain	Marginal
5	4	3	2	1

3. How well satisfied do you feel the users are with the products of this project? (Circle one)

24

Highly pleased	Well satisfied	Satisfied	Somewhat dissatisfied	Dissatisfied
5	4	3	2	1

4. Were there implementation problems associated with this

25 project? (Circle one)

Skip 26-27

No problems	Very minor problems	Moderate problems	Considerable problems	Very serious problems
5	4	3	2	1

E. Computer Operating Cost:

MIS Manager or Computer Operations Manager

1. Has this project caused problems for computer operations?

28 (Circle one)

No problems	Very minor problems	Moderate problems	Considerable difficulties	Very serious problems
5	4	3	2	1

2. Would you say the costs of operation for this project are

29 excessive? (Circle one)

Definitely not	Probably not	Not certain	Probably are	Definitely are
5	4	3	2	1

3. Are you running this project less frequently than the users

desire? (Circle one)

30

Run Whenever desired	Usually run as desired	Not certain	Run much less than desired	Virtually never run
5	4	3	2	1

UNIVERSITY OF Minnesota

APPENDIX C

LETTER REQUESTING PARTICIPATION IN STUDY

MANAGEMENT INFORMATION SYSTEMS RESEARCH CENTER
SCHOOL OF BUSINESS ADMINISTRATION
MINNEAPOLIS, MINNESOTA 55455

July 9, 1970

Representative's Name
Position
Firm
Address

Dear Mr. Representative:

One of our MIS doctoral students, Dick Powers, is doing research on the organizational and procedural correlates of success with MIS projects. Dick has reached the point where he desires to gather data on twenty MIS projects for a statistical analysis of several hypotheses he has set up. He hopes to collect the required data by interviewing selected people in ten associate firms (two MIS projects per firm) during the period 1 October to 31 December, 1970.

Within the next several days, Dick will be contacting you to arrange an appointment of about thirty minutes duration to explain more fully the research he is doing, and to discuss what will be involved on your part should you agree to participate. I believe the research is most worthwhile and hope you will elect to participate.

Since Dick will be doing all of the data collection and analysis himself, it is appropriate that you know something about his qualifications and background. To this end, a brief biographical sketch is attached.

Thank you for your continued support and cooperation.

Sincerely,

Gary W. Dickson
Associate Professor

GWD/jls
Enclosure

Brief Biographical Sketch of Richard F. Powers

Dick Powers is currently a doctoral student majoring in management information systems at the University of Minnesota. He entered the MIS program in the fall of 1968 and has now completed all course work required for the PhD. Dick is a lieutenant commander in the Supply Corps of the U.S. Navy, and is being sponsored in his doctoral studies by the Navy. He holds a BA degree from Rice University, 1958, and an MBA from Michigan State University, 1965.

Since his commissioning as an ensign in 1958, Dick has held the following positions up to the time he entered the MIS program at Minnesota:

1959-1960	Supply and Disbursing Officer, USS MASSEY (DD-778)
1961	Aide to the Commanding Officer, Naval Supply Center, Norfolk, Va.
1962-1963	Director of Data Processing, Naval Supply Center, Norfolk, Va.
1964	Control Division Officer, Royal Canadian Naval Supply Depot, Victoria, British Columbia
1965	MBA program, Michigan State University
1966-1968	Director of Computer Training, Navy Supply Corps School, Athens, Ga.

UNIVERSITY OF Minnesota

APPENDIX D

BRIEF DESCRIPTION OF STUDY

MANAGEMENT INFORMATION SYSTEMS RESEARCH CENTER
SCHOOL OF BUSINESS ADMINISTRATION
MINNEAPOLIS, MINNESOTA 55455

Research on the Correlates of MIS Project Success

Nature of the Research:

An empirical investigation of sixteen organizational and procedural factors hypothesized to be correlates of success with MIS projects.

Methodology:

Study two MIS projects in each of ten organizations with as wide representation across industries as possible.

Criteria of Success for a Project:

Time
Cost
User satisfaction
Computer operating problems

Data Collection:

By structured interview that follows a pre-tested questionnaire. The responses are anchored, and multiple scales are used wherever possible to improve reliability of the results.

For each project selected for investigation the following individuals will be interviewed with the interviews requiring approximately the amount of time shown:

Individual	Time
Project Leader	2 Hours
User Management, Level 1	½ Hour
User Management, Level 2	½ Hour
Project Total	3 Hours
For Two Projects	6 Hours

In addition to the above interviews for each of two projects in each organization, interviews will be conducted with the following individuals to collect computer operating information or information not specifically related to one project:

MISRC Associate	½ Hour
Manager of MIS	½ Hour
Manager of Computer Operations	½ Hour
	1½ Hours
Total Interviewing Time per Organization	7½ Hours

Data Analysis:

All data collected will be analyzed statistically using non-parametric techniques such as X^2. Qualitative analysis of various moderator variables will also be made.

Expected Results of the Research:

1. Confirmation or rejection of the numerous prescriptions appearing in information systems literature.

2. A ranking or other classification of those organizational and procedural factors related to MIS project success in the operational, real-world environment. This ranking or classification will have more general meaning for MIS management than previous case studies.

3. The manager should be able to judge more accurately which organizational and procedural factors are most critical to project success given a particular set of circumstances.

Assurances to the Participating Organization:

1. Reported results of the research will be made available to the participant company.

2. No company names nor non-public financial information will be reported without the express prior permission of the company.

3. No information provided by an individual will be divulged to any other person or be attributed to the individual in the report without the express prior consent of that individual.

4. All information gathered will be retained personally by the researcher at all times.

APPENDIX E

VARIABLES INCLUDED IN THE STUDY

Variable Number	Variable Name / Variable Description and Scoring	Source Page	Source Question(s)
1	ASSETS	206	3a
	Collected as a measure of relative size of organizations in the sample. Asset data were not available for three of the organizations.		
2	SALES	206	3b
	Total sales or other gross revenue measure for the past fiscal year. Not available for two of the organizations in the sample.		
3	EMPLOYEES	206	3c
	Number of employees in domestic operations of each organization. The only measure of organization size which was available for all organizations in the sample.		
4	CUSTOMERS	206	3d
	Total billed customers. Collected as a measure of relative organization size. Not available for two organizations.		
5	ORGANIZATION CHANGE	207	4
	Degree of organizational change during past three years; scaled from "no change" at high end (5) to "extensive change" at low end (1). Pertains to changes affecting the whole organization as opposed to intrafunctional realignments.		

6 HARDWARE INVESTMENT/SALES 207 5

Measure of investment in computing hardware and supporting equipment relative to total revenue for past fiscal year. If owned, equipment valued at replacement cost or current list price for identical or comparable equipment. If rented, monthly rental price multiplied by 40.

7 HARDWARE EXPENSE/BUDGET 207 6

Represents the proportion of last fiscal year's budget for the information systems function that was accounted for by hardware cost (depreciation and/or rental).

8 CENTRALIZATION 207 7

Centralization of analysis, design and programming activities in the organization. Scaled from complete centralization (5) to decentralization (1). This variable was not adequately tested by the present sample; eight organizations were scored at 5 level and remaining two were scored at 4 level. The latter two were not at the 5 level solely because of small operations research groups which did their own design and programming. For this reason, Variable 8 is not tabled with other variables in the study.

9 LEVEL OF INFORMATION SYSTEMS MANAGER 208 8b

Number of hierarchical levels between the manager of the information systems function and the top operating executive of the organization. Scaled from no intervening levels (0) to four or more intervening levels (4). The lower the score on this variable, the higher the information systems function in the organization.

10	NUMBER IN SYSTEMS & PROGRAMMING	208	9
	This variable, the total number of personnel engaged in systems analysis, design, and programming activities within the organization, is used as the numerator for computing the value of Variable 61.		
11	ORIGINATOR	209	1
	This variable identifies the primary originator of a project being studied. It is scaled from user origination (4) to information systems staff origination (2); there were no projects reported as "other" (1). In terms of rankings, high rank is given to user originated projects; middle rank to those of top management origin; and low rank to systems staff originated projects.		
12	MEASURABLE PROJECT OBJECTIVES	209	3
	The project leader's perception of nature and clarity of project objectives. Scaled from highly specific and measurable objectives in writing (6) to very vague objectives (1).		
13	COMPLEXITY	210	4
	Project leader's perception of the complexity of this project as compared with others the organization has undertaken. The higher the scale value for this variable, the greater the complexity, with most complex scored 5 and least complex scored 1.		
14	PROJECT TEAM	210	5
	Dichotomous variable scored 1 if a project team including user personnel developed the project, and scored 0 if there was not a project team comprised, in part, of user personnel.		

15	USER MAN MONTHS/TOTAL MAN MONTHS The proportion of man months spent on the project accounted for by user personnel. Variable 15 value will be 0 for all projects where value of Variable 14 is 0, indicating a project team including users was not employed.	210	5c
16	USER CONTRIBUTION TO TEAM Project leader's perception of the contribution of user members of the project team to project success. A value for only 13 projects that used team. Not included in the statistical analysis.	211	5h
17	NUMBER ON PROJECT Total number of personnel, including users and consultants, if any, who worked directly on the project at any time.	211	6
18	NUMBER OF ANALYSTS Number of analysts who worked on project. Not included in the statistical analysis.	211	6
19	NUMBER OF PROGRAMMERS Number of programmers who worked on project. Not included in the statistical analysis.	211	6
20	NUMBER OF USERS Number of user personnel, if any, who worked directly on project. Not included in the statistical analysis.	211	6
21	ELAPSED MONTHS Number of months included in period from formal start of project to project completion; project completion	211	7

	defined as date when project turned over to computer operations for production running.		
22	MAN MONTHS	211	8
	Number of man months spent on project by all personnel directly involved with project, including analysts, programmers, user members of project team, and consultants, if any.		
23	COMBINATION ANALYST/PROGRAMMER	212	9
	Dichotomous variable scored 1 if combination analyst/programmers were used on the project, and scored 0 if the analysis and programming tasks were performed by separate individuals or groups.		
24	SYSTEMS EXPERIENCE OF PROJECT LEADER	212	10a
	Total number of months systems experience the project leader possessed at the start of the project. Systems experience defined to include programming or systems work performed outside of a data processing organization, such as methods and time studies. This variable not used in the statistical analysis; Variable 27 used as the systems experience variable in all reported cross-tabulations. Variable 24 was highly correlated with Variable 27, the tau value being .418, which is significant at the .014 level (two-tailed).		
25	MEAN SYSTEMS EXPERIENCE OF PROJECT PERSONNEL INCLUDING USERS	212	10b
	Mean number of months systems experience for entire project team, including user personnel and consultants, if any. Comments under Variable 24 concerning definition of systems experience and tabulation apply fully to Variable 25. Tau value for		

	Variable 25 vs. Variable 27 was .596, which is significant at the .0006 level (two-tailed).		
26	MEAN SYSTEMS EXPERIENCE OF PROJECT PERSONNEL FROM MIS STAFF ONLY	212	10c
	Mean number of months systems experience for those personnel from the information systems function who worked on the project. This value the same as the value for Variable 25 for those seven projects where a team not used. Comments under Variable 24 concerning definition of systems experience and tabulation apply fully to Variable 26. Tau value for Variable 26 vs. Variable 27 was .575, which is significant at the .0004 level (two-tailed).		
27	TWO OR MORE YEARS SYSTEMS EXPERIENCE	212	10d
	Proportion of the project staff, including users and consultants, if any, with two or more years systems experience. Systems experience defined exactly as for Variables 24-26. This measure of systems experience considered to contain the least distortion from extreme values.		
28	IMPACT OF SYSTEMS EXPERIENCE	212	10c
	Project leader's opinion of the impact that prior systems experience of project personnel had on project success. Scaled from highly critical to success (5) to a lack of systems experience detrimental to success (1). This variable not tabled in the statistical analysis.		
29	TURNOVER	212	11a
	The percentage turnover of the project staff. Any person who left the project staff at any time prior to completion of the project was considered		

	as contributing to turnover unless that person's assigned tasks had been completed. If a person who left the project prematurely was replaced, the replacement was also considered as a factor in the numerator of the turnover computation. The denominator of the turnover computation was the "normal" or median number of personnel on the project staff multiplied by two.		
30	COLLEGE DEGREE	213	12a
	Proportion of project staff that held a college degree. Although not used as the primary measure of the level of education, Variable 30 did make a contribution to the interpretation of certain relationships, and for this reason it has been cross-tabulated with other variables where significant relationships existed.		
31	TWO YEARS COLLEGE	213	12b
	Proportion of project staff that had completed at least two years of college. This proportion included all of those who held college degrees, and was, therefore, very strongly associated with Variable 30. Since Variable 31 contributed nothing to the study which was not picked up by using Variables 30 and 32, it is not tabled in the statistical analysis.		
32	MEAN YEARS FORMAL EDUCATION	213	12c
	Mean number of years formal education for the project staff, including users and consultants, if any. This variable used as primary measure of level of education for project staff.		

33	MEAN YEARS ORGANIZATION EXPERIENCE Mean number of years experience in the organization (firm, not function) studied for project staff members. Not included in the statistical analysis since Variable 34 believed to be a less distorted measure of organization experience.	213	13a
34	TWO OR MORE YEARS ORGANIZATION EXPERIENCE Proportion of the project staff, including users and consultants, if any, possessing two or more years experience in the organization (firm, not function) studied. This variable the primary measure of organization experience.	214	13b
35	DOCUMENTATION STANDARDS Dichotomous variable scored 1 if documentation standards were prescribed for the project, and scored 0 if such standards were not prescribed.	214	14a
36	QUALITY OF DOCUMENTATION Project leader's appraisal of the quality of documentation for the project. Scaled from high quality (4) to serious problems with documentation (1).	214	14e
37	STANDARDS APPRAISAL The sum of two separate perceptions by the project leader; how important he felt the documentation standards were plus how well the project staff complied with the standards. Since Variable 37 made no contribution to the analysis of documentation standards or quality, it is not tabled.	214	14b 14c

38	SPECIFICITY OF USER REQUIREMENTS--PL Project leader's perception of the clarity and specificity of user requirements and desires at the beginning of the project. Scaled from very clear and specific (5) to very vague (1).	216	15d
39	USER MANAGEMENT INTEREST Project leader's perception of the interest and participation of top level user management in the development of the project. Scaled from very active participation (5) to disinterested (1).	216	15e
40	CHANGED AS REQUESTED Project leader's perception of the response by the project staff to user requests for changes in any aspect of the project during the development period for the project. Such changes may have entailed merely output format modifications or may have required major logic alterations. Scaled from always made requested changes (5) to never made such changes (1). If no changes of any kind were requested by the user, scored 5.	216	15f
41	USER PARTICIPATION--PL Project leader's perception of the level of user participation in the project. An aggregate variable representing the sum of three separate items. Scaled from very great participation (15) to very little (3).	215	15a 15b 15c
42	PROJECT CONTROL Project leader's rating of the type and frequency of progress reporting for the project. Scaled from formalized, monthly progress reporting (5) to no progress reporting (1).	216	16

43 HIGH LEVEL PROGRAMMING LANGUAGE 217 17

Projects programmed in COBOL were scored 3; those programmed in FORTRAN were scored 2; and those programmed in some assembly language were scored 1. For the purposes of this study, COBOL was considered a higher level language than FORTRAN.

44 GENERALIZED SOFTWARE PROBLEMS 217 18

Project leader's perception of the existence and seriousness of operating system or other generalized software problems with respect to this project. Scaled from no problems (3) to major problems (1).

45 SPECIFICITY OF USER REQUIREMENTS--USER 217 1a

Users' perception of the clarity and specificity of user requirements and desires at the beginning of the project. Scaled from very clear and explicit (50) to very vague (10).*

46 USER PARTICIPATION--USER 217 1b
218 1c
1d
1e

Users' perception of the level of user participation in the project. An aggregate variable representing the sum of four separate items. Scaled from very great participation (200) to very little participation (40).*

47 ON TIME 219 1a

A dichotomous variable scored 1 if the project was completed within the calendar time originally estimated, and scored 0 otherwise. Variable 47 not used in cross-tabulations since Variable 48 was the primary time success variable used in the study.

48	ACTUAL TIME/ESTIMATED TIME The ratio of actual calendar months spent on the rpoject over calendar months estimated for the project. This variable is the criterion variable for project success in terms of time.	219	3
49	TIME SUCCESS--PL Project leader's opinion of the success of this project, in terms of time to complete it, relative to his experience with actual time/ estimated time for other projects. Scaled from highly successful (5) to very poor (1).	220	6
50	WITHIN BUDGET A dichotomous variable scored 1 if the project was completed within the original cost budget for the project, and scored 0 otherwise. Variable 50 not used in cross-tabulations since Variable 51 was the primary cost success variable used in the study.	220	1
51	ACTUAL COST/ESTIMATED COST The ratio of actual cost of the project over estimated or budgeted cost for the project. This variable is the criterion variable for success in terms of cost. Where cost data were not available, this ratio computed based on actual and estimated man months for the project, along with an estimated factor for computer test time.	220	
52	COST SUCCESS--PL Project leader's opinion of the success of this project, in terms of cost, relative to his experience with actual cost/estimated cost for other projects. Scaled from highly successful (5) to very poor (1).	220	4

53	IMPLEMENTATION PROBLEMS--USER Users' perception of the problems experienced in implementing the project in their organizations. Scaled from no problems (50) to very serious problems (10).* Although this variable is actually a component of Variable 54, it is also treated separately for comparative purposes.	221	4
54	USER SATISFACTION--USER Users' perception of the success of the project in terms of five separate factors which were summed to derive one overall measure of user satisfaction. Scaled from high user satisfaction (250) to low user satisfaction (50).* This variable is the criterion variable for success in terms of user satisfaction.	221	1 2 3 4 5
55	SATISFACTION OF OBJECTIVES--PL Project leader's perception of the degree to which project objectives were satisfied. Scaled from definitely satisfied (5) to not satisfied (1).	223	1
56	PROJECT SUCCESS--PL Project leader's global perception of the overall success of the project. Scaled from extremely successful (5) to marginally successful (1).	223	2
57	USER SATISFACTION--PL Project leader's perception of user satisfaction with the products of the project. Scaled from users highly pleased (5) to users dissatisfied (1).	223	3

58	IMPLEMENTATION PROBLEMS--PL Project leader's perception of the problems encountered in implementing the project. Scaled from no problems (5) to very serious problems (1).	223	4
59	COMPUTER OPERATIONS PROBLEMS Perception of the manager of computer operations, or his superior in some cases, of the problems caused by the project for computer operations. Scaled from no problems (5) to very serious problems (1). This variable is the primary criterion for project success in terms of computer operations.	224	1
60	COMPUTER OPERATIONS COST Perception of the manager of computer operations, or his superior in some cases, of the computer operating cost for the project. Scaled from cost definitely not excessive (5) to cost definitely excessive (1).	224	2
61	SYSTEMS STAFF/TOTAL EMPLOYEES A measure of the relative size of the organization's systems staff (analysts and programmers). Computed by dividing the total number of analysts and programmers (Variable 10) by the total number of domestic employees of the organization (Variable 3).	Computed from Variables 3 and 10	

* Note: All variables representing users' perceptions were scaled up by 10^1 to avoid using fractions where there were two or more responses per item which were averaged to derive one value for that item. Such scaling, of course, had no bearing on the relative rankings which were used in the analyses.

APPENDIX F

COMPUTING FORMULAS USED[1]

The following procedures and formulas were used in computing the values of tau-B, tau-C, S, variance of S, and the normal deviate of S:

1) All observations on two variables being cross-classified were entered into a naturally ordered table of the following type:

j=1 to c columns

i=1 to r rows

i \ j	5	4	3	2	1
175	1	0	0	1	2
150	0	1	0	2	0
130	3	0	0	1	0
92					
58			etc.		
47					
40					X_{ij}

$$n_{i.} = \sum_{j=1}^{c} X_{ij}$$

$$n_{.j} = \sum_{i=1}^{r} X_{ij} \qquad N = \sum_{j=1}^{c} n_{.j}$$

In the above example case, there are five possible levels for one variable, and these are represented by the columns. There are seven possible values for the second variable and these are represented by the rows. Any one observation of the total N observations must fall in one of the cells of the resulting array. Thus,

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[1] Most of what is presented in this appendix is taken from the appendix of UMST 590, the computing program used for the data analysis, which, in turn, is from Kendall (1962).

the entry in each cell is merely the number of observations falling in that cell, or having the values of variables one and two that intersect in that cell.

2) $S = P - Q$

where $$P = \sum_{i=1}^{r-1} \sum_{j=1}^{c-1} \sum_{k=i+1}^{r} \sum_{\ell=j+1}^{c} X_{ij} X_{k\ell}$$

$$Q = \sum_{i=1}^{r-1} \sum_{j=2}^{c} \sum_{k=i+1}^{r} \sum_{\ell=1}^{j-1} X_{ij} X_{k\ell}$$

3) For square tables (where $r=c$), Kendall's tau-B was computed as follows:

$$\text{tau-B} = \frac{S}{\sqrt{\tfrac{1}{2}N(N-1)-T}\ \sqrt{\tfrac{1}{2}N(N-1)-U}}$$

where T and U are factors representing the number of ties in the ranking of each variable, and are computed as follows:

$$T = 1/2 \sum_{i=1}^{r} n_{i.}(n_{i.}-1)$$

$$U = 1/2 \sum_{j=1}^{c} n_{.j}(n_{.j}-1)$$

4) For rectangular tables (where $r \neq c$), Kendall's tau-C was computed as follows:

$$\text{tau-C} = \frac{2S}{N^2\left(\frac{m-1}{m}\right)}$$

where m is the smaller of r or c.

5) The normal deviate of S can be computed only after the variance of the S statistic has been determined as follows:

$$\text{VAR } S = \frac{1}{18}\left[N(N-1)(2N+5) - \sum_{i=1}^{r} n_{i.}(n_{i.}-1)(2n_{i}+5) - \sum_{j=1}^{c} n_{.j}(n_{.j}-1)(2n_{.j}+5)\right]$$

$$+ \frac{1}{9N(N-1)(N-2)}\left[\sum_{i=1}^{r} n_{i.}(n_{i.}-1)(n_{i.}-2)\right]\left[\sum_{j=1}^{c} n_{.j}(n_{.j}-1)(n_{.j}-2)\right]$$

$$+ \frac{1}{2N(N-1)}\left[\sum_{i=1}^{r} n_{i.}(n_{i.}-1)\right]\left[\sum_{j=1}^{c} n_{.j}(n_{.j}-1)\right]$$

6) The normal deviate of S can next be computed by:

$$Z(s) = \frac{S^*}{\sqrt{\text{Var } S}}$$

*Before computing the normal deviate, S is corrected for continuity as follows:

a) for a 2 x 2 table, $|S|$ reduced by $\frac{1}{2}N$ unless $S \leq \frac{1}{2}N$, in which case $S = 0$.

b) for all other tables, $|S|$ is reduced by 1.

These corrections for continuity are made to adjust the distribution of S closer to the normal distribution where there are ties in either or

both of the rankings being cross-classified. However, where the extent of tied ranks is very great, the correction in (b) above may not be enough. This is particularly true where one ranking is a dichotomy and the other ranking has ties of varying extents in it. In these last cases, an actual distribution of S for each set of variables cross-classified would need to be determined to arrive at the continuity correction required.[1]

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[1]For discussions and proofs of the correction for continuity applied to S under various cases of tied ranks, see Burr (1960), Kendall (1947; 1962), Sillitto (1947), and Whitfield (1947).

APPENDIX G

COMMENTS OF USER MANAGEMENT

Each user interviewed was given the opportunity at the end of the interview to make whatever comments he felt were germane to the project being studied. Specifically, each user was asked what he felt should have been done to improve the effectiveness and value of the project with respect to his information needs. Further, the user was asked to elaborate on any aspects of the project which he felt required additional development work.

The comments included in this appendix provide some flavor of the attitudes of user managers toward the projects studied. Since verbatim notes were not taken by the researcher, the comments presented here are best described as "paraphrased user comments". However, the comments are presented in the form of statements by the users rather than descriptive narratives of the researcher.

1. Problems that were apparent from the beginning have never been corrected. There has been virtually no follow-through by the project staff to help us work with the system. We have also been unhappy with the validity of the input data; we don't consider the reports we're getting to be very reliable.

2. We have learned a great deal from the experience of working with the system. We now feel there is too much historical information provided in the outputs; completed transactions should be purged from the files so that they do not appear in our reports. Also, there has been a lack of training for the people preparing the input data. This has resulted in too many input errors which makes us suspicious of the validity of the outputs.
3. There was too much pressure from top management to get something going in a hurry to meet an immediate problem. This led to inadequate planning and preparation. I think we are trying to do too much with the system; we should reduce the scope of this project and focus just on the heart of the problem, rather than trying to do everything for everyone with one project.
4. We want a good deal more now than we envisioned needing when the system was designed. The original outputs were fine, based on what we said we wanted, but we have been unable to get changes made that we feel are necessary now.

Another problem was that the salesmen who provide the input were never involved in system design. As a consequence, they cannot see any results from the coding they are doing--they see no specific outcome and tend to feel they are wasting their time.

5. This is a very valuable application. The opportunity to evolve with it and to incorporate needed changes in phase two was crucial to our getting useful outputs.
6. We are just getting too much paper. We need reports oriented to the needs of the individual decision maker.
7. From our standpoint, the system is not worth too much. The production engineers who are supposed to use the system had little or no voice in designing it. Higher level managers were involved in defining the system, which we believe resulted in outputs more oriented to accounting needs than to production requirements. The reports are too voluminous and hard to use; there should be more exception reporting.
8. I get a lot of performance figures, but these are meaningless to me without some standard

or scale for comparison. What is good, bad, acceptable? I don't believe there is a real means for a manager in my position to use the system--to really be an effective influence on actions taken. Although some of the other managers were involved in developing the system, I don't believe I had enough voice in it.

9. We don't get the output in a format that is usable. Our analysts still have to rearrange the data and prepare the required reports by hand. However, I think the blame for this situation falls on us--we did not state explicitly enough what was needed.

10. Eighty to ninety percent of our information requires output formatting of a certain type. We don't get that type of output at all. The need for this type of output format was <u>very</u> clearly specified in the original project request.[1]

11. It seems that the original objectives were satisfied well enough, but it is apparent now

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[1] Comments 9 and 10 came from two different users of the project outputs in the same organization.

that we did not really know what we wanted or needed when we started. We have grown with experience with the present system--we now have a better grasp of what information we should be getting but are unable to get it with the present system. Among the specific shortcomings, as I see them, are: the information is not now current or accurate enough to make the kinds of decisions we should be making; reports are too detailed and voluminous--we need much more analytical reports that satisfy our information needs directly without further manipulation; and too many people are involved in data preparation with no effective input quality control.

12. The form required to be filled out for an inquiry run is rather complex. As a result, some potential users have not used the system as they could. I guess this may partly stem from the fact that all potential user areas were not well enough represented and involved in original system definition.

13. Due to the way the project was developed, and the way it is now used, the field sales force is very opposed to the forecasting system.

They were not consulted in the development efforts, and they have no input to the processing cycle now. However, I guess there has been a time constraint that precluded our including the field sales force in the processing cycle.

14. Very simply, we did not ask for enough; we did not specify what we wanted clearly enough; and the result is that we are still doing too much manually.

15. I can think of a couple of things that are probably related. First, the documentation has been inadequate in that changes to programs have often not been reflected in documentation nor communicated to users. Second, the field training of operating people has been inadequate which, I think, accounts for some of their resistance to the system.

16. There are too many inaccuracies in the data--inadequate input controls and data validation. Also, the reports are too detailed and difficult to use for vice presidents and assistant vice presidents. Finally, we have had implementation problems. We are not getting the reports where and when we should in some cases. This, combined with inaccuracies, is frustrating.

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